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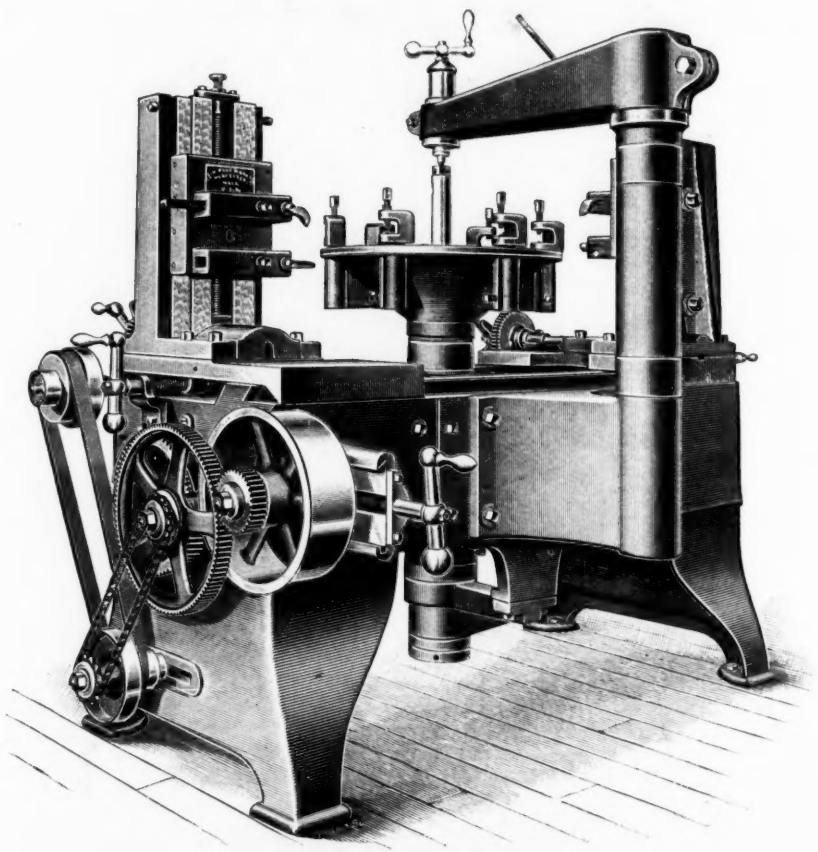
Pulley Turning Machine.

We give on this page an illustration of an improved pulley turning machine which has a vertical spindle with face-plates of various sizes to suit the diameter of pulleys being turned, the pulley being placed upon an arbor and driven by dogs which clamp it by the arms.

The machine has two heads that move upon horizontal slides on the bed. Each of these heads has a tool holder carrying two tools, and the heads can be set to turn straight or crown face pulleys.

There is a center support for the upper end of the arbor, as shown, and the arbor is fitted to the spindle so that the pulley when placed upon it is accurately centered, after which the driving dogs are tightened upon the pulley arms while free to move within the plate, thus avoiding spring of pulley. The dogs are then tightened in the plate in the position determined by the pulley arms, and as they take hold of the latter near the rim the driving is strong and steady.

The machine is driven by a broad belt running upon a plain pulley, change gears being used to obtain a uniform cutting speed regardless of size of pulley. The machine is, of course, designed only for use where considerable numbers of pulleys of one size can be turned in a single lot. A set of change gears and four different sized face plates or chucks accompany each machine. Machines are built in three sizes, the No. 1 to turn pulleys 12 inches to 30 inches diameter, 14 inches face; No. 2 for 12 inches to 36 inches diameter, 14 inches face, and No. 3 for 12 inches to 40 inches by 20 inches face. The machine is built by the L. W. Pond Machine Co., Worcester, Mass.



PULLEY TURNING MACHINE.

"Direct Grip" Hoist.

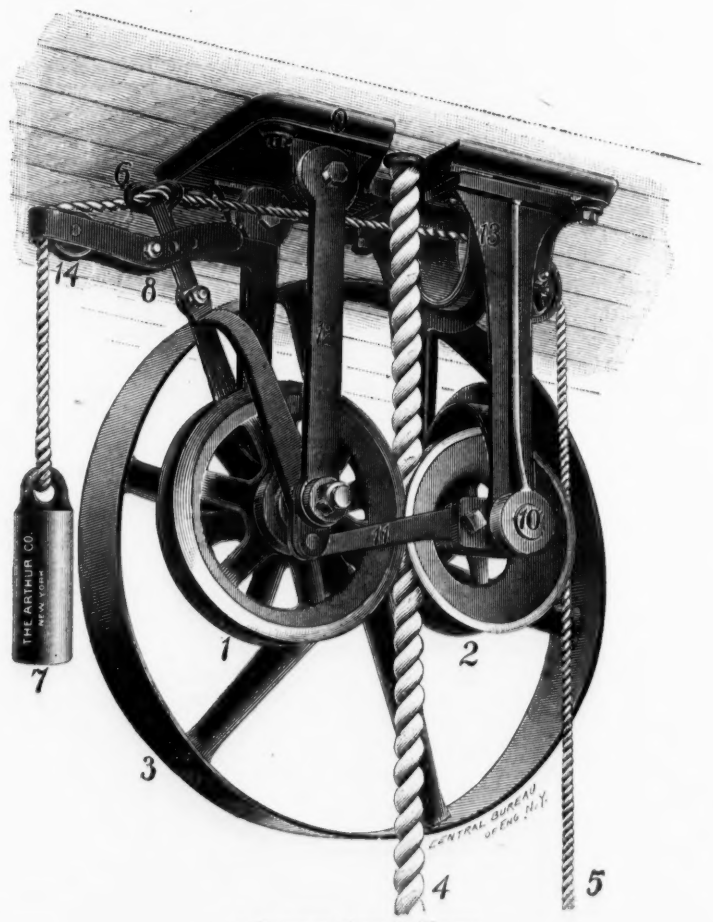
The accompanying illustrations (pages 1 and 2) show a hoist of very simple construction intended to replace hand labor in such hoisting as is done in many warehouses where a hand rope running over a large sheave-wheel at the top of the building gives motion to a small drum upon which the hoisting rope, with platform or hook attached, is wound.

This hoist is so arranged as to use all the apparatus already in use, merely substituting power for the hand—in giving motion to the hand rope.

The large pulley seen receives motion by a belt from the motor (which may be electric, water, or steam) or from a shaft, and upon the same shaft with it is the sheave pulley 2, which runs continuously. Pulley 1 is hung in swinging links so arranged that it can be swung into contact with pulley 2, and, being made in two parts arranged to close together, when lateral pressure is applied outside its rim it is thus closed by pulley 2 when crowded into its groove. The result of this is that pulleys 1 and 2 then become friction gears, 1 being driven by 2, and between these the hand rope is firmly gripped and driven.

A pull upon the small rope applies the power, and the weight 7 releases it when the rope 5 is released. The arrangement, where an electric motor is used, is seen on page 2.

Being "direct," *i. e.*, no gears being used, there is an entire absence of noise, and the machine has been found in practice to work with entire satisfaction. The speed of hoisting may, of course, be arranged to suit circumstances, but can in every case be very much faster than is possible by hand, and the capacity will depend upon the character of the original hoist to which it is applied. It is made by the Arthur Co., 86 John street, New York.



"DIRECT GRIP" HOIST.

Guaranteeing the Performance of Steam Engines.

The practice of guaranteeing the economic performance of a steam engine is very likely to lead to misunderstanding from the fact that the purchaser does not take time to think, or, perhaps, cannot be made to comprehend what the guarantee really means. For example, the purchaser gets an engine guaranteed to do 300 horse power of work, on a consumption of two pounds of coal, with the boilers already in use, or to be furnished, as per specifications, by another party. This seems to be plain enough, and it is plain enough to those trained in steam engineering matters, but the purchaser is not generally so trained—knows nothing of the technicalities of the subject—and the sequel is likely to demonstrate that it was never plain to him.

The engine is put at work, and the purchaser multiplies 300 by two, compares the result with his coal bills and concludes that he has got something more than he has paid for. The coal consumption appears to be less than the guarantee. But a little later on his engineer discovers that the engine is developing but 150 horse-power, and that the coal consumption is very materially more than two pounds. The result is dissatisfaction and an appeal to the builder. Then comes the difficulty of making the purchaser understand that the engine must be loaded to 300 horse-power to comply with the terms of the guarantee. His understanding goes as far as the two pounds of coal, and sticks there.

Again, the owner may be using an inferior quality of coal, while, if nothing is said to the contrary, the builder is entitled to the best quality. This inferior quality of coal may be—owing to its low price—much the most economical, and, very probably, is all the purchaser had in his mind when the contract was made, and it is no simple matter to make him understand that the contract comprehended the use of high-priced coal not easily had, perhaps, in the vicinity. When this point is raised, he is quite likely to think he is being swindled, or, at least, unfairly dealt with.

Still again, the builder may object to the way the plant is managed, and insist upon an expert test to determine the matter. The purchaser had in mind the consumption of coal with the plant in charge of his engineer. Interwoven with that two-pound guarantee is a consideration of what it is going to cost him a year for fuel, and not what the possibilities of a 10-hour run with experts at $50 a day may be.

Frequently of late, especially when one party furnishes the engine and another the boilers, the builder of the engine will guarantee a certain duty based upon a stated boiler efficiency. This does away with trouble as to poor fuel, and in a measure as to boiler efficiency, but not entirely as to the latter, as there is a chance for disagreement if the boilers prime to an extent that makes it necessary to take this into account.

It is just as well to guarantee the engine on the pounds of steam required per horse-power, but to most men not engineers, the pounds of coal required is the point about which they desire to be satisfied. Pounds of steam is to them a meaningless expres-

sion. Pounds of coal is what they have to pay for, and this they comprehend without an explanation, which they scarcely understand in the end.

Take it altogether, the difficulties (and these can be no more than briefly referred to here) in the way of determining to the satisfaction of the purchaser, if it comes to a close test, whether he has been fairly dealt with or not, whether or not the engine he is expected to pay for is performing according to contract, are frequently of serious magnitude. And the difficulties of making a test—getting the engine properly loaded, interruption of work, probably, etc. —are so great that there is seldom any actual test made unless the engine is a large one. The buyer purchases from a firm that has established a reputation for honest dealing and for building an engine that uses steam with good economy, and the matter rests there.

It comes about in one way and another that the qualities—good or bad—of the different steam engines on the market get pretty thoroughly known, and the buyer is not likely to make a mistake in buying any one of them on its established merit, without requiring close guarantees of its absolute performance. In fact, some of the best known builders of steam engines will not give such guarantees, such builders appreciate the fact—and think others do—that there is no incentive for them to sell engines that will not give satisfaction. On the contrary, their future business depends upon selling those that will give satisfaction, and the very fact that it is considered necessary to submit their engines to a fine spun test is distasteful to them.

But, on the other hand, new engines are being brought out, and in order to get them into the market it is sometimes necessary to go to considerable length in the way of guarantees. And, not unfrequently—through over-anxiousness—guarantees are made that could never by any possibility be fulfilled. Sometimes this makes trouble, but more frequently it is passed by as being—between that and a suit at law—the lesser of two evils.

It should not be inferred that purchasers of steam engines are always or generally hard to be convinced. The contrary of this is frequently true, as, for example, in one instance an engineer was called in by an engine builder to satisfy a purchaser that an engine was working up to contract. The guarantee was two pounds of coal per *net* horse-power. After some re-arrangement of valves, which seemed advisable, a test was begun at 9 o'clock in the morning, the intention being to make a continuous run of 24 hours. The regular firemen were retained and indicator diagrams were taken at the usual intervals. No more than a half-dozen machines were driven by the engine, but each required very considerable power; sometimes one and then another machine was idle for a considerable time, of which fact a record was made. This was all plain enough, but it was supposed the trouble would come in the fixing of the friction of the engine to the satisfaction of the purchaser, who knew as much about his business of manufacturing as any one in the country, but who knew nothing about steam engineering, although he owned a dozen engines. About 4 o'clock in the afternoon, he came around and called for the coal tally sheet and the record of time the different machines had been in operation. Then, with the remark that he knew exactly the power required to drive every one of those machines, he figured for a few moments, tore up the paper on which he had made his calculations and threw it away, with a remark to the effect that the test need not be continued on his account; the engine was doing better than the contract called for, and he should at once send a check in payment. He said this in a way not to be disputed, and the test was stopped. He insisted, however, that the engine was not working up to contract until after the re-arrangement of the valves, which may or may not have been so. The only question at issue was the satisfaction of the purchaser that he was getting what he paid for, and it was a good deal better than a lawsuit or the severing of long-standing business relations.

Notes on the Theory of Shaft Governors.*

BY ALBERT K. MANSFIELD.

At our spring meeting of 1890, at Cincinnati, three papers on shaft governors were presented, which, together with the extended discussions thereon, make a valuable contribution to the literature of this subject.

It is the purpose of this paper to add something to that discussion with the hope of getting a little nearer to a correct solution of the perplexing problems surrounding the subject.

The matter to be discussed will be divided into several topics for the sake of clearness.

1. *The path of an unbalanced governor ball of a shaft governor, isochronously adjusted.*

This problem was proposed by Professor Sweet in one of the papers referred to, and in an elaborate mathematical analysis Prof. S. W. Robinson seems to prove that the center of the approximately circular path is vertically above the center of the shaft, and that the distance apart of these centers may be determined from the formula $h = \frac{9\ 78}{n^2}$; h being the distance sought, in inches, and n being the number of revolutions per *second*.

Confirmatory of this result an experiment was made with an unbalanced weight, arranged according to the requirements of the problem. The figure illustrating the experimental apparatus is here reproduced (see Fig. 1).

The spring adjustment was such that this apparatus was thought to be isochronous at 555 revolutions per minute, and the experimental determination gave $h = 0\ 126$ inch (mean of several trials), while by the formula h 0.114 inch—a fairly close agreement.

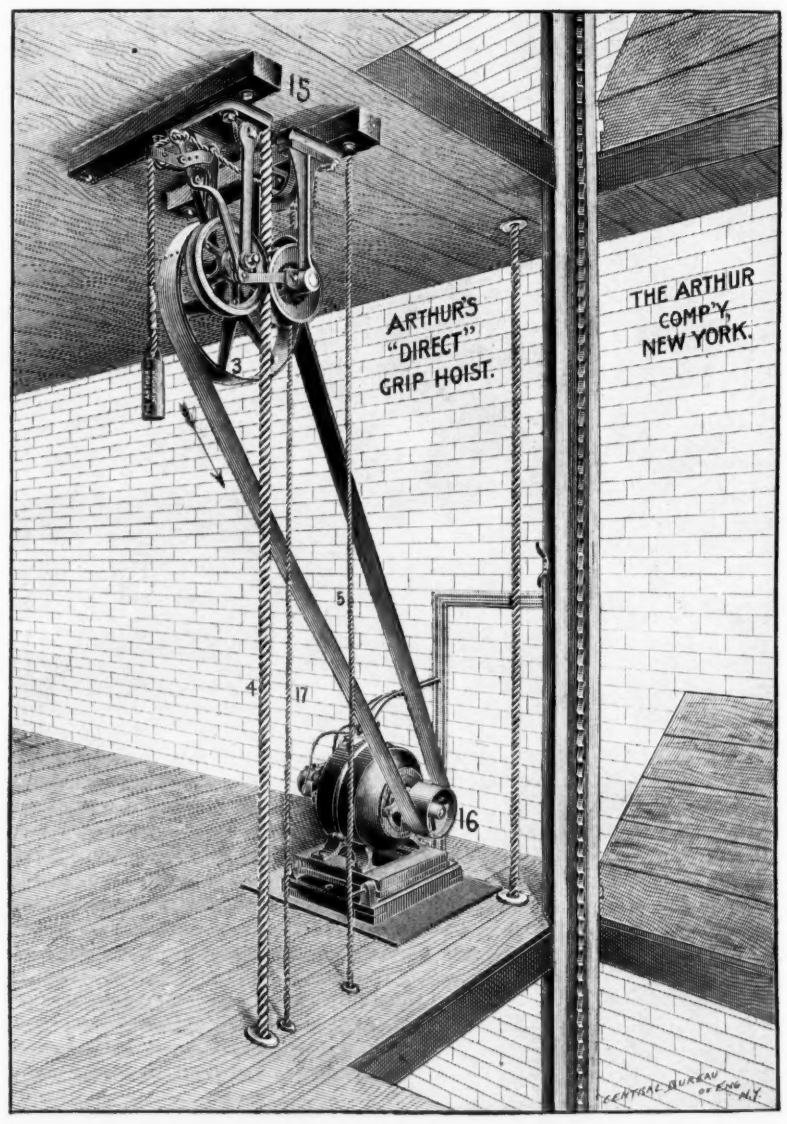
Following this a table of values of h was given derived from the formula, revolutions per minute being taken at from 1,200 as a maximum, down to 60; h in the former case being by calculation 0 02 inch, and in the latter 9 78 inches.

Suppose this table to be extended to cover slower speeds than 60 revolutions per minute, even down to one revolution per minute, h would be found at this speed to be, by the formula, 35,200 inches, or 2 933 feet —more than half a mile above the center of the shaft.

This extreme result is noted merely as a curious matter of interest

The formula is doubtless correct, as deduced from the assumption on which it is based; but let us examine the assumption.

Referring to the figure of Professor Sweet's paper, here reproduced (Fig. 2), Professor Robinson says: "Suppose, to start with, that the weight B is at j, moving along a horizontal portion of arc. The action of gravity tends to deflect it downward instead of allowing it to move along a circular path concentric wtth the shaft, thus giving the mass B an accelerated motion relative to the wheel A, and along the radius $A\ B$, so that by the time the weight reaches a it will have a considerable velocity toward the center C. From this point on gravity counteracts, and on reaching d will have destroyed the radial velocity toward C when B will again be moving horizontally, or perpendicular to the radius, but will be at a point nearer the center C than when at j. Now, from this point on a radial acceleration will occur, so that at g the weight will be moving outward with a radial velocity which, from g on to j will again be destroyed by gravity, thus bringing the weight to rest on the radius at j, though at a greater radial distance from the center C than at any point before in the revolution and putting the weight in the position and condition supposed at the start, when it will go on in repetition of the curve as the next turn of the shaft is made, and so on, continuously, the curved path described being found to be nearly a circle, with its center elevated above that of the shaft."



"DIRECT GRIP" HOIST. (See page 1.)

The questionable part of this reasoning lies in the first sentence: "Suppose, to start with, that the weight B is at j, moving along a horizontal portion of arc." Under this supposition what follows is justified; but the supposition is only one of an indefinite number that may be made with equal correctness, each leading to a different conclusion.

For example, suppose we start the analysis from the point a, the weight being assumed to have no radial movement at that point, and the motion to be right-handed. Then, during the entire first half-revolution, an accelerating force is drawing the weight away from the center, always faster, until at g this force becomes zero, and the velocity outward is uniform. During the next half-revolution, a force of equal effect acts to draw the weight toward the center, but this force must be entirely expended in overcoming the velocity of the weight outward, which it had when at the point g, therefore, the movement of the weight is outward during the whole revolution. The same action occurs in succeeding revolutions, and the weight describes a spiral outward, finally reaching its outer stop.

If we start the analysis from g, we find by similar reasoning that the weight describes a spiral inward.

The reasoning in the case of starting from g or a, which does not permit the ball to return to its starting point, is found to be rational, when compared with the case of any weight moved in a straight line, with no resistance except that of inertia, by an accelerating force, and stopped by an equal retarding force. The weight comes to rest, and no work is gained or lost, yet the weight is found in a new position.

Again, if we consider the weight to start, with no radial movement, from any other points intermediate between its positions, a, g, and j, d, it will be found to describe a spiral outward when the first position is taken at the right of the axis, and inward when at the left. These spirals are, as will be seen by consideration of the forces of inertia, in no case regular spirals, but are merely of spiral nature, not re entering.

The conclusion to be derived from this analysis seems to be that the problem has no true solution, or if any expression based on correct reasoning could be found for the curve, it would be irrational.

Moreover, under the conditions of perfect isochronism assumed, one would be led to expect the motion of the ball to be erratic; as, for instance, it might first move in the outer spiral, when, reaching the outer stop, it may be compelled to move horizontally at the point j, which might start it in the eccentric circle. Slight disturbing influences, as of the atmosphere, would probably change it from this to other of its paths. This expectation seems to be to some extent verified by the experiment of Professor Robinson, for we find in his table of results the remarks "spiral inward," "spiral outward," "steady," etc.

The practical conclusion to be derived from this analysis is that an unbalanced weight in an isochronous shaft governor is not feasible.

2. *Centrifugal moment of a governor weight.*

Theorem: The centrifugal moment about the weight pivot, like the simple weight moment, is the same wherever on the line through the center of gravity of the weight to the center of the pivot the weight be considered as concentrated.

Let A, Fig. 3, be the center of the shaft, B the center of gravity of the weight, and C the pivot center or fulcrum.

In considering simple weight leverage about C, the effective weight may be assumed to act at any point on the line $B\ C$, as at E, in which case the weight at E is to the actual weight at B as $B\ C$ to $E\ C$. The centrifugal moment of weight B for any given number of revolutions is proportional to the radius $B\ A$ times the line $G\ C$, drawn at right angles to $B\ A$ through C. The centrifugal force of the resultant weight E is similarly $A\ E$ times $D\ C$; $D\ C$ being drawn at right angles to $A\ E$ prolonged.

According to the theorem,

* A paper read at the Montreal meeting of the American Society of Mechanical Engineers.

$A\,B \times G\,C \times C\,E = A\,E \times D\,C \times B\,C$, the lines $C\,E$ and $B\,C$ being the relative weights in the two cases.

Proof: Draw the line $F\,A$ at right angles to $B\,C$. Then we have the similar triangles $A\,F\,B$ and $C\,G\,B$; also $A\,F\,E$ and $CD\,E$,

from which $A\,B : A\,F = C\,B : C\,G$,

and $C\,E : C\,D = A\,E : A\,F$.

Multiplying the equations together, and equating product of means to product of extremes, we have

$A\,B \times G\,C \times C\,E = A\,E \times D\,C \times B\,C$

as asserted.

This goes to show that the attempt, which is evident in many shaft governors, to so design them that the center of gravity of the weight shall move nearly in a radial line is unnecessary. Wherever the weight be concentrated on the line $B\,C$, provided its amount be sufficient, the result is the same whether the arc described approaches a radial line or not.

This demonstration leads up to another interesting detail, which seems to show that shaft governors are not always arranged for true isochronism.

3. *Position and tension of spring.*

In Fig. 4 let A be the center of shaft, B the center of gravity of weight, and C the weight pivot, as before. Since the line $A\,B$ may be taken as a measure of centrifugal force of B, then a line from A to B at any other position of B in its arc will be, in an isochronous governor, assuming uniform velocity, a corresponding measure of the centrifugal force of B in this new position, as the line $A\,B_1$ for the position B_1. Suppose a pull spring pivoted so as to swing about the point A, and to be pivotally attached at its outer end to the center of gravity of B; also, suppose the spring to be of such tension and strength as to exactly balance the centrifugal force of B. Suppose, also, that the line $A\,B$ represents the total extension of the spring—*i. e.*, that when the end B of the spring is at A the force of the spring is zero—then the spring, from the laws of spring tension, will just balance the centrifugal force of the weight B in other positions, as at B_1. The arrangement is therefore isochronous, for centrifugal and centripetal forces are exactly opposed to each other in direction and amount.

Take any point E, as before, on the line $B\,C$, and draw the line $A\,E$; consider $A\,E$ to represent a spring pivotally supported at A and pivotally connected at E, and of such force as to counterbalance the centrifugal force of B, or of its resultant weight at E. Then, if the zero of tension of this spring is at A, it will counterbalance correctly the centrifugal force of the weight at all other positions, as at E_1, for the spring lies in the line of action of centrifugal force, and its leverage $D\,C$ about C is the same as that of the centrifugal force. From which it is clear that a spring pivotally adjusted at A and pivotally connected to the weight-arm *at any point* on the line $B\,C$, is correctly located to produce exact isochronism.

In Fig. 5 let A, B, B_1, and C represent shaft, weight, and pivot, as before. Draw lines $A\,C$ and $B_1\,A$. Draw an arc from C through any point E on the line $B\,C$, cutting $B_1\,C$ at E_1. From the point E draw $E\,A_1$, parallel to $B\,A$, and connect A_1 to E_1. The figure $A_1\,E\,E_1$ is exactly similar to the figure $A\,B\,B_1$, and corresponding sides of the figures are parallel to each other. It will be clear from the foregoing and from inspection, that if a spring be pivotally connected from A_1 to E, and has its zero of tension at A_1, and is adjusted to balance the centrifugal moment of the weight, it will balance it in all other positions, as at E_1. But the arc $B\,B_1$ need not have been drawn through the center of gravity B, for, from the previous demonstration (see Fig. 3), it could have been drawn through any other point of line $B\,C$; therefore, the line $B\,A$ might have had any direction between that of the direction of the line $A\,C$ to that of the direction of a line $A\,B_2$ parallel to $B\,C$. Such an indefinite number of constructions would bring the point A_1 at any position on the line $A\,C$, or its continuation through A.

It has, therefore, been shown that a *spring pivotally swung at any point on the line $C\,A$, or its continuation through A, and pivotally connected to any point on $C\,B$ or its continuation through B, and having its zero of extension at the first-named point, is correctly placed to produce exact isochronism.*

Referring to Fig. 6, it will be clear without demonstration that the point of connection to weight-arm need not be on the line $B\,C$. It may be anywhere on the weight-arm, as at F, provided a new zero line $G\,C$ be drawn angularly the same distance and direction from $A\,C$ as the line $F\,C$ from $E\,C$.

It follows that the point of connection of spring to weight arm, and the direction of action of spring, *may be selected entirely at random*, or for convenience, provided only that the length between pivots and the tension of spring be fixed according to the principles laid down.

The conclusions arrived at by the preceding reasoning may be expressed in the form of a second

Theorem: The combined zero and fixed pivotal point of a spring, arranged to act isochronously on any point of the line of weight arm from weight pivot through center of gravity of weight, may be taken at any point on the line from weight pivot through center of shaft. Moreover, the spring force required will be inversely as the distance of the fixed pivot from the weight arm pivot.

In Fig. 7, letters $A\ A_1\ B\ C\ E$ represent the same parts as in Fig. 5. Drop perpendiculars $C\,G$ and $C\,D$ from C on lines $A\,E$ and $E\,A_1$ respectively; also from E drop the perpendicular $E\,F$ on line $A\,C$. Then similar triangles $A_1\ E\ F$ and $A_1\ C\ D$, as well as $A\ F\ E$ and $A\ C\ G$, are formed, from which proportions may be made as follows:

$$A\,E : E\,F = A\,C : C\,G,$$

$$A_1\,C : C\,D = A_1\,E : E\,F.$$

Multiplying together, equating products of extremes and means, and canceling $E\,F$, we have

$A\,E \times C\,G \times A_1\,C = A_1\,E \times C\,D \times A\,C$,

or $A\,E \times C\,G = A_1\,E \times C\,D \times \dfrac{A\,C}{A_1\,C}$.

If we consider $A\,C$ to be the unit of force of the spring when the fixed pivot is at A_1, and $A_1\,C$ the unit of force when the pivot is at A, then this becomes intelligible.

It shows that the linear extensions of the springs $A\,E$ and $A_1\,E$ multiplied by their leverages $G\,C$ and $C\,D$ and by the units of force of the springs, are equal. The points E and A_1 were taken at random, which makes the demonstration general.

A further consideration of Fig. 3 will show that when A is the fixed pivot the unit of spring force is inversely as the distance of the point of connection on line $B\,C$ from C.

If, therefore, we have computed the centrifugal force of the weight B, we have merely to multiply this centrifugal force by the ratio $\dfrac{B\,C}{E\,C} \times \dfrac{A\,C}{A_1\,C}$ (see Fig. 5 for illustration) to find the corresponding balancing spring force; or to multiply the centrifugal force per inch of radius by this ratio to find the corresponding spring force per inch of extension. The linear extension of the spring was before shown to be $E\,A_1$.

4. *Approximate isochronism.*

In Fig. 8 let $A\ B\ C$ be the centers of shaft, of gravity of weight, and of pivot, as before. Draw a line from B through A to any point O. Let O be the fixed point of a spring pivotally attached to B, and having its zero of extension at A. It is clear that the arrangement may be made isochronous for the two positions A and B. For the moment consider O to be infinitely removed from A, and investigate the mid position of B at B_1. Draw $B_1\ O_1$ parallel to $B\ O$, and $A\ A_1$ parallel to $B_1\ C$, also $A\ B_1$, and $D\ C$ at right angles to $A\ B_1$ through C.

Let $A\ C$ be represented by R, and the angle $A\ C\ B_1$ by a. Then the spring moment at B_1 is R^2 sin. a, and the centrifugal moment is $2\ R^2$ sin. $\frac{a}{2} \times$ cosin. $\frac{a}{2}$, which expressions are equal to each other, by trigonometry. Therefore, with a spring so located and adjusted, a third point, B_1 is isochronous. If the point C is a finite distance from A, as shown, it will be found that there will still be a point B_1, near the middle of the arc $A\ B$, which will be isochronously balanced; other points, however, between A and B_1 will have their spring moment too small, and points between B_1 and B will have their spring moment too large.

Suppose the spring to be arranged as in Fig. 9, the point B_1 being the inner or initial position of the weight B; then clearly, from previous demonstrations—O being the pivotal point of the spring—to produce isochronism at points B_1 and B, A_1 must be the zero point of the spring. It will be found, as before, that a point nearly midway between B and B_1 is also isochronous; also, if the angle $B\ C\ B_1$ is not large, the approach to complete isochronism is very close.

This corresponds to the arrangement

Fig. 1.

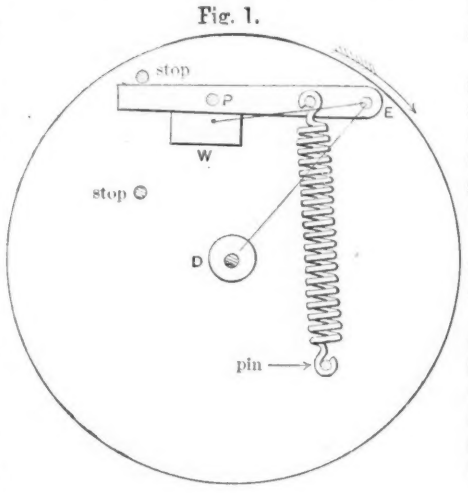


Fig. 2.

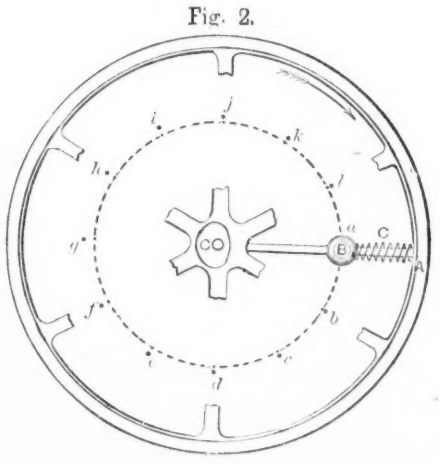


Fig. 3.

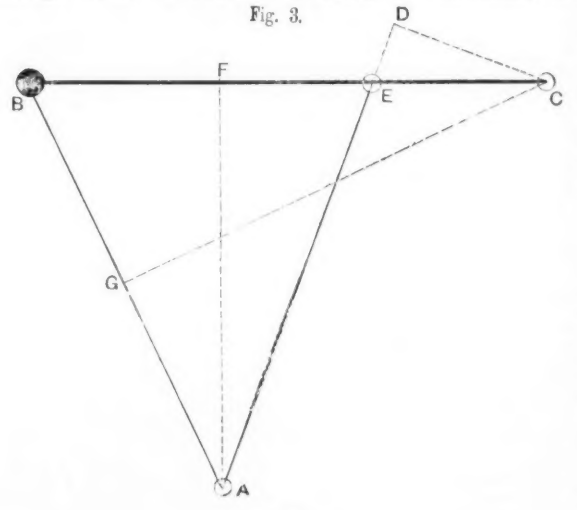


Fig. 4.

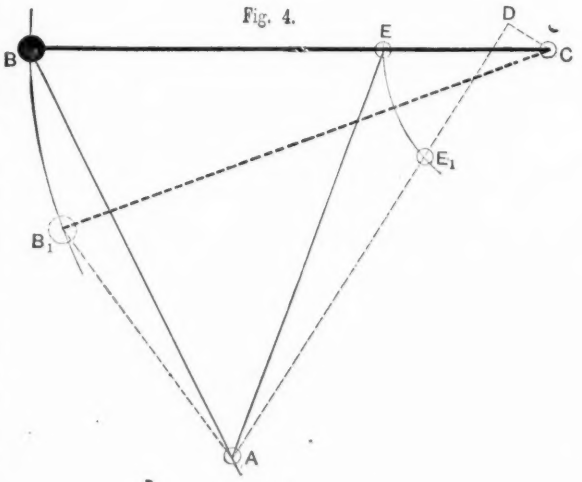


Fig. 5.

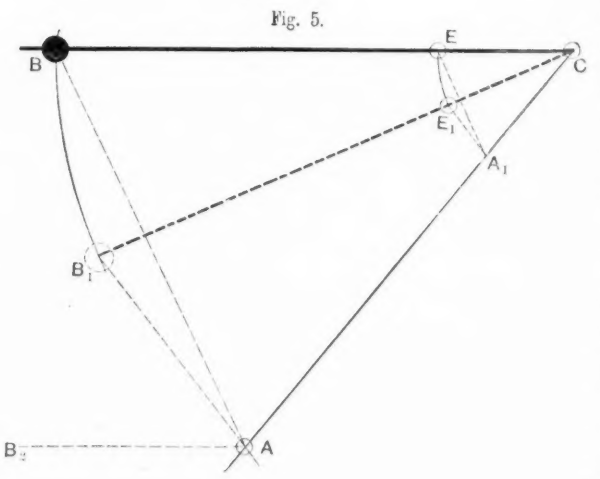


Fig. 6.

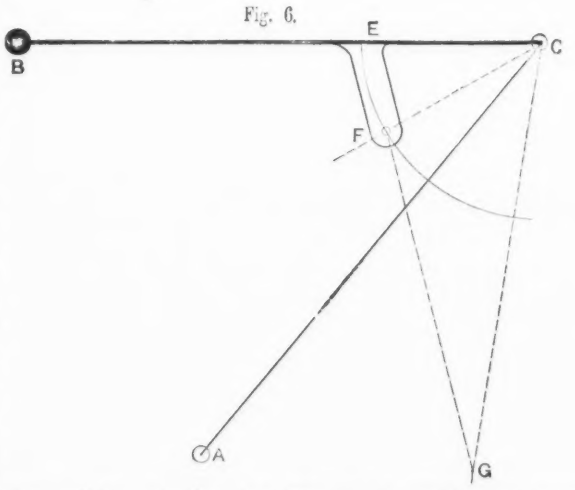
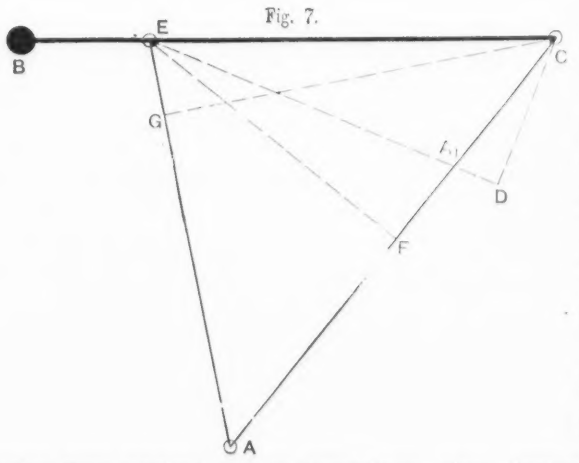


Fig. 7.



commonly used in practice. Clearly, the arc $B\,B_1$ may be drawn in any other place from C as a center, as at $D\ D_1$, the line of the spring being made to pass through these two points, and their angular distance apart being the same as that of B and B_1.

5. *Influence of the weight of the spring*

Let the spring be applied as in Fig. 10, and let G be its center of gravity. Determine its moment m of centrifugal force about its pivot O, and divide by the length of the spring $D_1\ C$, which we will call l. Owing to the weight G being constant, and the direction of l practically always the same $\frac{m}{l}$ is very nearly constant—m being the moment of centrifugal force and l the length of the spring—for any degree of extension between D_1 and D, and the quantity $\frac{m}{l}$ is the tangential force at D, due to the centrifugal force of the spring. Extend the arc $D\ D_1$ across the line $A\ C$, and lay off each side of the line to F and F_1 one half the arc $D\,D_1$. Draw radial lines from G to F and F_1. Draw a circle through C whose diameter is the chord $D\ D_1$. From A draw lines tangent to this circle, crossing the radial lines $C\,F$ and $C\ F_1$ at K and K_1. Let d represent the distance $A\ K$. Then, since $\frac{m}{l}$ is the force, $\frac{m}{l\,d}$ is the weight, which, concentrated at K or K_1—according to the position of the weight arm $B\,C$—will produce a centrifugal moment about C almost exactly equivalent, at the three points $K\ K_1$, and O_1, to the centrifugal moment due to the spring weight. Between the extreme positions K and K_1 and the central position O the action of such a weight is not exactly equivalent to that of the spring, but with a moderate arc the error is extremely small.

The object of determining the location and amount of the equivalent weight K is to find the influence of the spring on the location of a correct center of gravity line $B\,C$.

(*To be continued.*)

Rifled Mortar Carriages.

Builders Iron Foundry, Providence, R. I., says to the public:

The 12 inch breech loading rifled mortars described in our pamphlets "Our share in Coast Defence, Part I. and Part II.," have proved so attractive a subject, and the demand for those pamphlets has been so great that we have thought a description of the carriages on which these mortars are mounted will also be of interest to engineers, machinists and others who desire to be familiar with what is being done by the government toward protecting our coasts. We accordingly shall publish a pamphlet giving a full account of the construction of the carriages, and following quite closely the wording of the report of the government inspector at the works.

Should you wish a copy we shall be pleased to send it to you.

A woman in a city near New York has invented a practical way of capturing burglars, and as it is not patented and ought to work well in any city it should be made public. Hearing a burglar breaking in the house she raised the window and shouted "fire." Some one turned in the alarm, and with the remarkable promptness that characterizes the movements of firemen, they easily arrived in time to capture the thief. Suppose, for a moment, she had shouted police.

Mr. Henry Marx, of the G. A. Gray Co., Cincinnati, is in New York arranging for opening a New York store in which representative specimens of the various types of planers built by the Gray Company will be kept for the inspection of those interested in planers. He has secured space in the heart of the machinery district, at 121 Liberty street.

Oil Fuel.

By W. H. Booth.

Americans are well situated as regards liquid fuel with their large sources of petroleum, and have had a most valuable experience in the use of it at the World's Fair, though there may be disputes as to whether it was cheaper than coal in actual money cost. Not much has been done in England in the use of liquid fuel, but some progress has been made, especially upon the Great Eastern Railway, in which there are now running quite a considerable number of locomotives, the chief fuel of which is liquid, and usually a mixture of gas tar and distillation residuals.

In Russia, near the Caspian oil fields, the locomotives have long been fired by petroleum entirely, the fire-box containing a lot of more or less cellular fire brick, but in England where liquid fuel might become scarce or the price might be put up, it has been designed to be used in a combination furnace, which differs in nothing from an ordinary locomotive deep fire box excepting in having a couple of 5 inch tubes put through the back fire box plate into the fire-box at a height of a few inches above the fire-grate surface. In each hole an atomiser injector is placed that blows the liquid fuel by steam into the furnace; and round the nose of the injector is a ring of pipe perforated in front which can be made to blow an annular stream of air into the furnace when needed. As a rule, this extra air is needed to complete the combustion of the oil, and the point of perfect combustion can be told by watching the chimney, which pours out colorless gas only when sufficient air is blown in. A light fire of coal and chalk is maintained on the grate; this ignites the oil as it is injected. Both of the injector regulators are carried upon one fixing, and this fixing can be dropped and raised again by a single movement of another lever, whereby all supply of fuel is instantly stopped and as instantly put on again, exactly as before. Stopping at a station does not, therefore, affect the regulation of the combustion. This is stopped for economy when the engine stands, and yet no trouble is involved in re-starting owing to the above excellent device. On account of the ease with which the expenditure of heat can thus be checked, it is found that the liquid fuel gives a useful percentage effect per pound higher than is got from coal. The theoretical value of liquid fuel is about 75 per cent. above coal. Its practical value is about double. I have noticed when running on a liquid fuel locomotive that the fire box seems completely full of white flame, and that with a heavy train steam could any time be made to blow at the safety valve, as though the ordinary proportions of furnace necessary for coal were too great for liquid. Considerable of the increased efficiency of liquid fuel may arise from the clean state of the tubes. The injectors point towards the lower part of the fire-box back, and, of course, spray the oil upwards upon the brick arch and downward on the thin bed of fuel on the grates. With this arrangement of furnace coal can be instantly resorted to in event of liquid running short, or an engine could run its out journey on coal and run its home journey with oil on the remnants of its coal fire. An advantage of the compound system is that the small amount of solid fire may be the lighting-up fire. Of course, the solid fire burns away and needs an occasional shovel of coal to keep it self incandescent, but it can be run very dirty and is largely chalk. A locomotive is, of course, a peculiar service, irregular and intermittent and something is therefore required to effect ignition after a stoppage. For more continuous working, I do not see why—when the supply of liquid is assured—there need be any solid fire.

On the locomotives to which I refer the oil is suplied, at most, heated by a steam coil, which is provided in the oil tank, simply to add heat to give the oil the necessary fluidity, but there appears good reason to expect that if the oil could be very considerably heated before it is sprayed, its combustion would be still more perfect. It appeared to me probable, referring to one of the questions for topical discussion at the Montreal Meeting of the A. S. M. E., that it would usually only be requisite to regulate the fuel supply and the over-fire air supply, leaving the ash pit damper at one position throughout. There is, perhaps, always some air required to be put in above the bar surface, and this requires increasing with increase of fuel, and the only air necessary through the grate in the compound system is that to burn the solid fuel on the grate, and such liquid as falls in the form of liquid upon the solid fuel. I have no experience in oil-burning on any other system, except of observation of the Wells' and similar lights. The combustion of oil seems to be very perfect in a short time, wherein it differs from bituminous coal, and this is a special feature in oil of which makers of water-tube and coil boilers ought not to be slow in taking advantage. I am no believer in boilers that have a small water capacity any more than I am in engines without fly-wheels, for my experience is that boilers of small capacity are unsteady steamers, and liable to prime. If a sudden big call is made for steam from a large shell boiler, this can be responded to by a small drop of pressure while the fire is being gotten up, and similarly, when the demand for steam is over, the water will absorb the heat of the now active furnace with a moderate addition of pressure. Now, with oil-firing an instant's time and a turn of a hand-wheel will put the furnace into its fullest activity, or reduce it to its smallest dimensions to suit the demand for steam, and certain other defects of those boilers would be less felt with oil as fuel than with coal.

The instantaneous regulation of the turning effort on a steam engine crank would reduce the necessity for great weight of fly-wheel, and in the same way the quick response of the furnace makes it possible to reduce the water capacity of a boiler to such limits as the circulation of water and disengagement of the entrained steam may permit. For naval purposes weight or the want of it is so important that a coil boiler of light tubes will be preferred for torpedo boats, but unless great care be taken to prevent corrosion the giving way of a single tube may show that even lightness could be bought too dearly.

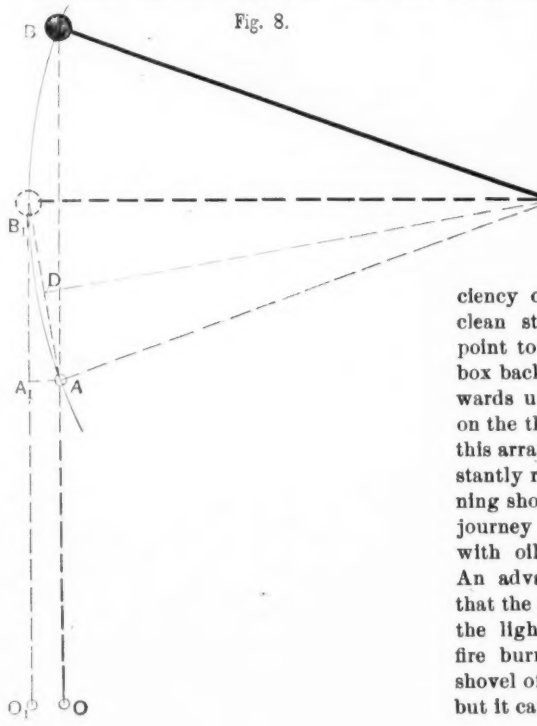


Fig. 8.

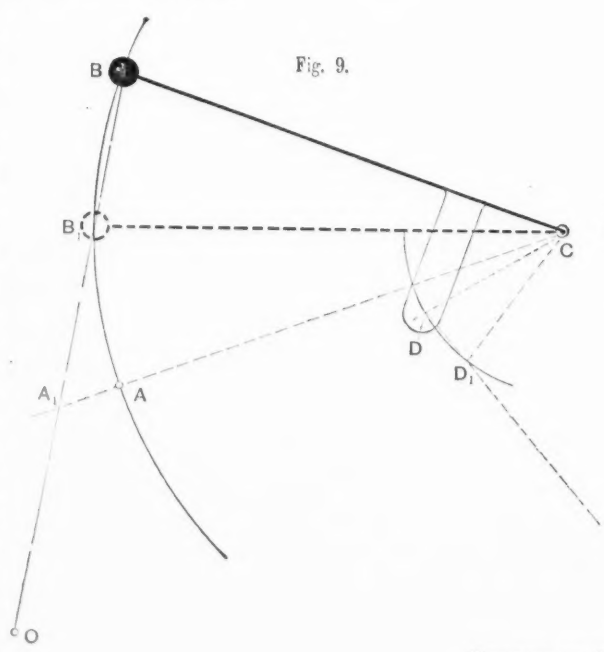


Fig. 9.

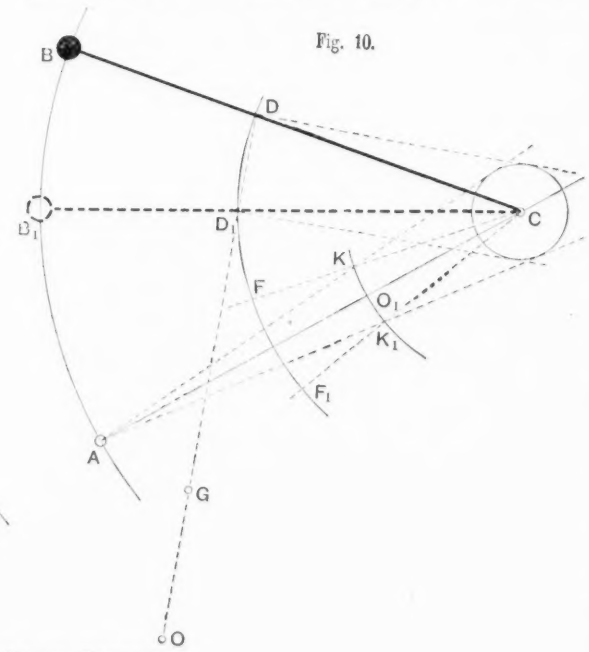


Fig. 10.

Theory of Shaft Governors.

The Engineer's Dog.

There is an engineer out on the Denver & Rio Grande Railroad who is the owner of a dog which is possessed of a good deal more than the average amount of canine intelligence. This dog is a bright little water spaniel, and has been accustomed to ride with his master on the engine since he was a puppy. He goes to the roundhouse about the time for his master's train to be made up, and mounts his own engine, having no difficulty in picking it out from the twenty or more other engines standing in the round house. He rides on the fireman's side of the cab, with his head and paws both hanging out of the window, intently watching the track. He often scents cattle at a long distance. When they appear in sight, he becomes greatly excited and barks furiously, looks first at them and then at his master, as though trying to make him understand the gravity of the situation. On a nearer approach to them he becomes almost frantic, and if it becomes necessary to come to a full stop, he bounds out of the cab, and running ahead drives the trespassers out of harm's way. He is well known to all the railroad men along the line, and if by chance he gets left at any station, he invariably boards the first train for home, where he patiently awaits the return of his master.—St. Louis *Globe-Democrat*.

Forging Lathe Tools.

BY B F. SPALDING.

There is a great deal of fine machinery in the world. It is well fitted, nicely finished, handsome, as being befitting in form, and is gratifying to the eye. It is all the while increasing in quantity, and, on the whole, improving, somewhat, in quality. But when you come to trace it back to the shop where it came from, you find pretty much the same old lot of tools on the boards that used to huddle together in all sorts of shapes some years ago.

Wherever the parts of these machines were generated—in whatever region of ether, the bold, and perhaps too grasping spirit of the designer snared the ideas which they embody, the gross matter, the substance in which they were materialized, the iron of which they were made, which, do not let us forget, is the same kind of dust that man, too, is partly made of, and which makes his blood red and hot, this iron has been made red and hot, and so took its definite shape on the rude anvil, or came into the world from the sandy matrix of the foundry. The crude tools that shaped them were the shovel and the hammer. The planer, the lathe and boring tools, not less simple, have finished them with precision to their permanent size and shape.

These fundamental tools, which are of the utmost importance, scarcely receive the attention they merit.

Machines, which machinists make for machinists to work with, will bear a much closer inspection than the machining tools used in their construction, because it is well understood that they will be subjected to the fault finding of divers persons who have their own notions which must be catered to, and therefore the machines must come up to a certain standard of excellence, and be made in every respect in what is universally agreed upon as a good and workmanlike manner.

But the tools a man is going to use himself, tools so temporary that they have to be ground every time they are used, have no waste energy laid out on them to beautify them, they may even become the victims of slovenly practices, of makeshifts. The workman is often intent only on getting at his work in the most direct way, and so that the main features are correct, and the tool does its duty well and quickly, now, he does not much mind if he does throw it into bad shape for future use. There still remains with him the remembrance of the censure his instructor administered for such doings when he was an apprentice, and he has a stealthy suspicion that he is doing a wrong thing. But he is not.

If you look at most any lathesman's tools —if he has been settled in his position a good while—you will find that he has a greater or less number of tools which have apparently been ground a good many times after they ought to have gone back to the tool dresser to be re-dressed. It is not often you find a lathesman that is vain of the looks of his tools. You will not find a hustler when you do. The man who is intent on showing something for his day's work had rather show his work than his tools. He knows they are all right for his use, but they have come to be what they are by a kind of compromise between exigency and conscience, and exigency got the best of it. He does not have to apologize for them; fortunately, they need no apology. But he does not brag on them. He knows what they can do, what they have done, and judges their value from that, and not from any finical notions anybody else may entertain.

When I was young in the tool-dressing business, and tools were brought to me altogether deformed in the grinding, I used to harbor the idea that the fellows who would abuse a tool and a grindstone in that manner ought to be born again, and try a new pedigree, but after a while I noticed that these same fellows got out as much work, and got it out as easy and as well as anybody, that they never got stuck on their jobs, that if they did not find an old path to tread in they blazed a new one. I never congratulated any of them on the originality of their ideas, but I got so that if a tool was required to be made of a very peculiar form to set on the back side of the lathe to cut a left handed thread, I kept as silent as the blacksmith who made the tap wrench with two holes in it for the boy inventor who proposed to use it to tap two nuts at the same time. If a tool was brought back to be redressed, which had been ground in such an uncouth and horrid form that it made a cold and awful shudder creep over my frame, and I knew it would have a cold shut if it was hammered together, I said it was "a bad day for the race," cut it off for a smooth end, and blocked out a new tool that I could warrant free from crack, check or cold shut.

There is a greater difference in tools than is perceptible to any one whose work is variable. One would hardly suppose without measuring the endurance of turning tools that some of those made by the most careful tool dresser, under uniform conditions, would do four times as much as

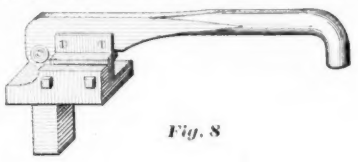


Fig. 8

Fig. 7

Fig. 6

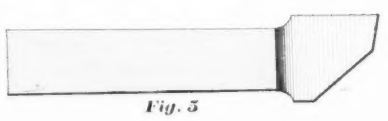


Fig. 5

Fig. 4

Fig. 3

Fig. 2

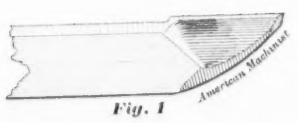


Fig. 1

others of the same kind, yet where a steady uniform kind of work, like turning shafting, has afforded opportunity for careful observation, this has often been found to be the case, not only with steel which required hardening, but also with self-hardening steel.

It is quite common to cut lathe tool stock into lengths proper for the tools, with the blacksmith's cold chisel, by marking the bar around with the chisel, and then laying it on the anvil with the cut above the square hole. Either the blacksmith or the helper strikes on it until it breaks, while the other holds his hammer above the piece to prevent it from flying when it is disengaged.

This procedure is apt to leave a ragged edge, which, when the tool is formed on that end, often works itself up into what is to be the cutting edge, and makes an edge that looks smooth enough in the forging, but which will nick out when it is cutting after it is hardened and ground. This is more noticeable on a tool with such a long cutting edge as a side tool (see Fig. 1). When it will not hold a smooth edge, the man who is using it does not know any better than to judge by appearances that it has been burned, frees his mind in the igneous dialect, reckons "the schoolmaster is abroad" and wonders if he's going to stay long.

Sometimes these little flaws, due to the bad breaking of the steel, will go into the edge a sixteenth, perhaps an eighth, of an inch deep. Talk about steel being better for being worked!—the more you work steel that is checked, the deeper you make the checks, like any other cold shut. Hammering will condense the steel, make its substance more compact, its grain finer, but it will not unite segregated atoms, whatever may have separated them; it will not close to the extent of obliterating it, even the slightest crack. Any kind of a lapse or interruption in the coherence of adjacent particles, any cessation or breaking off of the interlocking granular structure, causes trouble by interfering with the passage of the heat away from where it is generated by the friction of the cut. This transgresses one of the principal laws of tool-making, which is to fashion the tool in such a manner as to give free escape to everything you don't want to keep. That means get rid of heat, as well as chips. Carrying out this principle leads to enlarging some tools close to the cut, to making short, stocky teeth in cutters, that empty out the heat faster than slim ones. Little checks in the edge of a tool break it up into thin teeth, the heat accumulates, blocks up at its starting point, and makes the temper, the essential quality of the tool, irregular, uneven.

Tools which have such defects, from whatever cause, are improved by grinding, because after awhile, the defects being superficial, get ground out, continuity of structure is re-established, the grains come in contact with each other and afford mutual support, and the heat escapes on a straight road, without having to go around, or jump, intersecting chasms.

A better way to get the steel into the required lengths for tools than to cut it cold, is to mark it lightly with the cold chisel, and then, with a short fire, heat it to redness and mark it around an eighth of an inch deep, more or less, with a hot chisel, and put back into the fire to heat for marking the next one. Break them off when they have got down to a blue heat, not too near nor too remote from the red. A little observation shows what is the most sensitive temperature, for steel has a critical point in its temperature below a red heat, as well as one or two above it. If they are broken at this heat, they will have good ends. Side tools may be cut in pieces long enough to make two, and then divided by a diagonal cut across the center, which saves some hammering. The stock for cutting-off tools may be prepared in the same manner, but will be cut less obliquely.

As the side tool has the longest cutting edge, the cutting off tool has the shortest. Some men insist upon filing up their cutting-off tools after forging, before they are hardened. This is hardly necessary if the tool dresser will pay particular attention to his thickness and let it be nearly his last operation to trim the outside into the desired shape.

I have heard men assert that the proper shape for a cutting off tool is as is shown in Fig. 2, that such a shape was just as strong as that in Fig 3, and easier to grind. They claimed that if either of them was supported by the body in the tool stock, and subjected to a breaking strain applied at the point, it would break at the root of the blade, across *A C*, the widest place in the tool, but most severely strained because subjected to the concentrated stress due to the leverage. Others prefer to have them shaped as in Fig. 4, not caring a cent for the theory, and saying that if all the objection to that shape is the extra grinding, it will take a flash-light to find it. They want to get a top "rake," and wear out the tool by grinding from the top.

Fig. 3 is orthodox; its outline incloses the correct elliptical arc of accumulating support; its figure may not be any more perceptible to the unimaginative than the figure of the Great Bear among the stars, but it is surely there in stern and severe simplicity. It is an easy form to make, as the end trimming—dotted line *B D*—can be a little too slanting, and it can then be upset back, on the point, to set the front at the right pitch, and this operation will spread it a little, abruptly, on the point, which will be an advantage in shaping it at the grindstone on the flat sides.

As to the shapes of tools generally, the tool dresser finds that every one has his own notions, and a tool that satisfies any particular man's notions will do more work, in his hands, than any other tool, in the same hands.

Most persons prefer to have the cutting blade of a tool made in the center of the stock, as in Fig 6, thinking, I imagine, that it is steadier so, than if made on the side, as in Fig. 7. It is easier forged on the side, because it can be beat upon directly with the live striking hammers, without the intervention of the dead set hammer, and this is a considerable advantage when the stock gets so thin that the cold-set hammer resting on it, cools it before half a dozen blows can be given to it. Amateurs make a set hammer deader than death, by keeping it pressed down on the work, as though they meant to cool it quick enough to harden it for diamond cutting, but a good smith keeps his hot tool out of contact with everything, except at the moment of impact.

Amateurs are apt to take on too much stock, more than is needed, when they lay out for a cutting-off tool. The stock seems to draw out unaccountably. Half an inch of stock $\frac{5}{8}$ inch thick draws down into a cutting-off tool $\frac{1}{4}$ inch thick, twice as long as is usually wanted.

To make a center-bladed cutting off tool, give a few strokes, to make a very stunt point, and then set the half-inch fullers back far enough to take the necessary amount of stock, and drive them down nearly to the required thickness. Narrow up the stock that spreads between them as you go on. After you have done this, the stock beyond the fullering is so well away from the shoulders that it may be beat nearly to the proper thinness by live hammering, using the striking hammers directly on the stock. It may then be brought to its final finish thickness with the set hammer. The lower part should be made enough thinner than the upper to give the necessary side clearance. It should be widest at the point, which is of great importance; for, if it is widest at the point, and is set to stand perpendicular to the line of the centers, it will cut its clearance.

A good way to trim a cutting off tool into the required shape, after it is reduced to its thickness, is to shear it with the sharp-cornered set hammer, over a sharp-cornered stake fitted to the square hole, and extending to the front side of the anvil. They can be trimmed very well by marking them on the hardy, and breaking them at a blue heat. Or they may be cut to shape with the convenient little tool shear, shown in Fig. 8, which is made to fit the square hole in the anvil, and is very handy for many things, trimming flat drills, for one thing. The blades look rather thick in the figure; $\frac{3}{16}$ thick is about right, and $\frac{1}{4}$ inch to $\frac{5}{16}$ inch high above the jaws. A good practical width for a cutting-off tool on ordinary work, up to $1\frac{1}{2}$ inches in diameter, is $\frac{1}{16}$ inch to $\frac{1}{8}$ inch, and from $1\frac{1}{2}$ inch upwards, not over $\frac{3}{16}$ inch, unless the stock the tools are made of is more than $1\frac{1}{4}$ inches wide.

Cutting-off tools are of weak proportions when their length exceeds their depth. If the tool is to be longer than the stock is wide, do not narrow up, after fullering, to any less than the length. If the tool stock is $1\frac{1}{4}$ inches by $\frac{5}{8}$ inch, and the blade is to be $1\frac{3}{4}$ inches long in the clear, leave the stock at the bottom of the fullering $1\frac{3}{4}$ inches wide. The fuller will then leave the stock at the root of the blade in a shape that will afford all the support due from the sized stock of

which the tool is made. If this tool is not set out too far from the tool post it will be as strong, practically, as though it was made from stock 1¾ inches wide, as will be seen by referring to Fig. 5.

LETTERS FROM PRACTICAL MEN.

Some Gearing Rules.

Editor American Machinist:

The following two rules for computing gears I frequently find useful, especially when used in connection with the ones printed on the colored leaves of Brown & Sharpe's catalogue Perhaps some readers of the AMERICAN MACHINIST may find them useful also:

Having the center distance and the number of teeth in both gears, to find diametral pitch, divide half the sum of the number of teeth in both gears by the center distance.

Example—If the number of teeth is 50 and 30, and the center distance is 8 inches, add 50 and 30, making 80, divide by 2, and then divide this quotient 40 by the center distance 8 inches, and the result 5 is the diametral pitch.

Having the center distance, diametral pitch, and number of teeth in one gear to find number of teeth in the other, multiply the center distance by 2, from the product subtract pitch diameter of gear with known number of teeth, and multiply the difference by diametral pitch.

Example—If the center distance between two gears is 8 inches, the diametral pitch is 5, and one gear has 30 teeth, multiply 8 inches by 2, and from the product 16 inches subtract 6 inches, the pitch diameter of 30-toothed gear multiply the difference 10 by the diametral pitch 5 which is 50, the number of teeth in the other gear.

J. G. KINGSBURY.

Bridgeport, Conn.

Piecework.

Editor American Machinist:

I wish to say a few words in reply to Mr. Fredericks' remarks, in your issue of June 21st, regarding the piecework system.

In the first place, if all men were thoroughly honest and conscientious in their work, there would be no need of having work done "so much per piece." I am sorry to say such is not the case, and it has been my experience that the great majority of mechanics that I have come in contact with, would not do all that they were capable of doing in a day, for a day's pay. This one thing, I think, had led employers to see the need of a system that would be instrumental in getting out more work for the money paid.

I hold that all machine parts should be thoroughly inspected before being assembled, whether the work is done by the day or piece, and if mistakes have been made, it is far more easy to correct them before the machine is assembled than afterwards. By having the inspection done in this way by competent men, it is very rarely that pieces go through that are not correct.

I do not see where Mr. Fredericks makes a point when he cites the case of the superintendent who set piecework prices and made a failure of it because he was not a mechanic. This superintendent certainly should not have held the position he did, if he was not a mechanic. If a man goes at a job of setting piecework prices, he ought to be thoroughly posted as to the amount of feed that can be taken per minute, whether on a milling, planing, or drilling machine, etc., and having the number of inches to be worked, I see no reason why he is not able to arrive at a proper price to be paid for the operation.

For my part, I do not see how any machine builder can make estimates and bids for special tools, and be successful in securing the work, except he draws a line as to just what each and every part is to cost him. I am very sure from past experience this cannot be done by having the work done by the day. How many men running drill presses by the day ever think of using anything but the very finest feed? I have seen men who would stand up and feed by hand, rather than put on feed, simply because they could make a job last longer.

I will give my personal experience with piecework during the last year. One year ago, we were employing 120 men, and the work was all being done by the day. To-day we employ 60 men and have the piecework system, and are turning out more than double the amount of work that we did a year ago. The men in this particular shop are making from a quarter to two-thirds more money by the piecework system than they were by working by the day, and the percentage of bad work is a great deal less.

I have in mind a certain operation that cost a year ago $2.50; it now costs us 40 cents. I think the time is past for the "one man to-a machine idea," and for men to run one large planer, sit down and read a newspaper for half a day, while some 'poor cuss" across the room stands up to a vise and pushes a 14 inch bastard file for 10 hours on a stretch.

The piecework system should not be "cried down" because some men do not know how to use it to advantage, any more than a micrometer caliper should be abolished because a certain mechanic (so called) used it for a hand vise.

A SUPERINTENDENT.

A Brilliant Item.

Editor American Machinist:

Having noted in your paper of late several articles clipped by you from various sources and remarkable for their highly original setting forth of some mechanical facts, I am moved to send you the inclosed which I have had for some time, and have always considered as just about unapproachable. The item is as follows:

Heat usually lessens the tenacity of metals and increases their tenacity. Thus a copper wire about as thick as a common stout sewing thread may hold up, while cold, a weight of 25 to 30 tons, but if heated by a separate lamp, it will part with the same weight.

It was taken from *Power and Transmission*, published in Mishawaka, Ind., and is part of an article entitled "Mechanics in Plain English, No. XVII., Matter and its Properties," by Robert Grimshaw, and is in Vol. VII. No. 8, July, 1892. I would simply call attention to the wonderful results which might be attained by the use of this most tenacious of metals, if only the presence of lamps could be avoided, or they could be rendered inseparable. Also, to the beautiful exemplification in the first clause of the old adage, "It is a poor rule that won't work both ways."

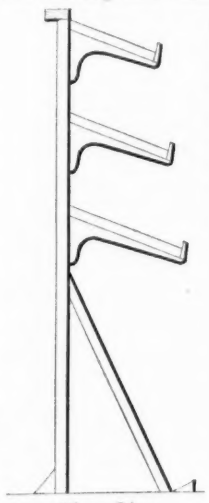
Holyoke, Mass. S. H. WHITTEN.

About Tool Rooms.

Editor American Machinist:

In your issue of May 31st Mr. W. H. Stedman expresses a desire for a discussion of tool-room methods and practices, and while my practical experience in the tool room, as tool-maker, has been limited to rather small shops, my observation has extended through many larger ones, and I have formed some opinions in consequence which may or may not be worth something to Mr. Stedman. The methods must fit the case you have to deal with, and no one scheme can hope for success in all places, so we will consider a few cases. For very small tools in a machine shop, such as small taps, reamers, etc., we have our choice between the "fluted board" (or, perhaps, "grooved" would be better) and the "block" system, *i. e.*, keeping them in groups, in blocks drilled to hold the shanks, such as are used to hold drills in sets, and, though an old method, this is very handy for such small tools and keeps them together and safe from harm.

By having rectangular blocks, of the correct size to hold such tools as are needed for similar operations, they can be kept in very little space in the tool closets or on the shelves. Of course, if these small tools are very long the "grooved board" is preferable and by having the grooves close together and racks to hold the boards these need not take up much room either. For ordinary taps such as are used in brass work (that is, not regular bolt taps and the like) the plan of dropping the shanks through a hole in the shelves and letting them hang by the head or tap end has much in its favor, and, as a rule, the heads are larger than the shanks, so that this can be readily done. In cases where the head is smaller than the shank just drive a wire staple in the under side of the board to prevent the tap falling through, this being much better than a solid bottom to the hole as it cannot collect dust and holds the tap just as well. Where this is not wanted, the groove idea can be carried out still further and the shelves made with grooves to fit the different tools, which is an expensive arrangement, but has some advantages. One disadvantage of this, however, is that it is not possible to change the tools from one place to another very readily unless they are very uniform in size. For example, a two-inch tap and a four inch tap could hardly change places with a good fit for both, and while this prevents them being misplaced, it is quite often necessary to make changes in the order or rank of tools owing to changes in the work, and new tools can hardly be introduced into the same group where the places are "carved" and fixed for each one. This is a disadvantage because it is far better to group tools as much as possible, keeping tools used on similar work in the same group so as to have them quickly found. For boring bars and such tools which vary in size but which are quite apt to assume large proportions, the plan I adopted in my small tool room seems as well fitted for a larger one having the same class of tools to deal with. This consists essentially in placing the bars against an inclined board which supports them and can also prevent their becoming mixed by having little strips or separations between the bars, although this is unnecessary in most cases, as the friction of the bars on the board will generally do this and without the strips it is much easier to alter the location of the bars when the occasion arises.



The accompanying cut will show the cross section view of the shelves as arranged in my smaller tool room, which was simply an enclosure in the main shop room made by a partition ("fence" the boys used to call it) four feet high, so that all the space had to be utilized, clear down to the floor. Similar plans to this are used in numerous larger tool rooms, only on a larger scale, and, when possible, the shelves should not be extended to the floor on account of the dirt which is bound to get in on them, but if this is necessary a cover can be fitted over, which can be hinged so as to be self closing. The main idea should, it seems to me, be to preserve the tools from injury, next, to have them readily accessible, and, last, to have them so arranged as to collect as little dirt as possible and to be readily cleaned of what does collect, for unless they are in air tight cases they will get dusty in spite of anything you can do. The price of keeping a tool room looking clean and bright is to have the tools wiped as often as possible, and in places where the most of the tools are in use from day to day this is not a hard matter as they can be wiped as they are received at the tool room before putting away; it is the tools that are seldom used that get dusty. As I have said before in these columns, the best helper I ever found for keeping the tools and shelves clear of dust, or, rather, for clearing the dust from the shelves, was a good heavy bellows from the foundry, or of that type, and while this will not take the place of wiping the tools and the shelves it will make the wiping less needed than where no bellows are used.

For jigs and such shop fixtures there seems to be nothing better than closets, which may or may not be in the tool room proper, according to circumstances, or, of course, they can be kept on shelves as other tools, but as most tools require a shelf a little slanted down so as to readily see what is there, the jigs can best be kept in regular closets for this purpose, at least, the jigs that I have in mind.

As to whether the jigs and *all* tools, etc., should be kept in the tool room is a debatable question, and for the most part depends upon circumstances, the class of work, and kind of men. Where one department of a shop, one corner, we might say, uses most of the jigs, or uses any jigs, in fact, those jigs and other special tools can, as a rule, be best kept in that department, in suitable closets, under the care of the foreman of that department. This prevents any time lost in sending to the tool room after them; prevents taking the tool room attendants' time, and saves time generally; but, on the other hand, it throws the responsibility for the jig being kept in good condition for accurate work on the foreman, unless the tool-maker is to inspect it periodically. How far this can be carried into other tools depends upon conditions, but as much as possible the tools used in one department can be kept there in suitable places, not in the workmen's private drawer, however, but in a closet made for the purpose. This practically makes a sub-tool room or auxiliary store house for tools, the tool making and the repair work on tools all being done at the central or main tool room. This has been adopted with success in several large railroad shops, and can generally be used, more or less, in any work.

This, of course, necessitates an additional supply of standard tools, such as taps and dies, wrenches, drills, etc, but the extra outlay will be repaid in time saved, and, of course, it is merely increasing the stock, and not increasing the number of broken tools to be replaced. A man becomes accustomed to the location of tools in the tool room, and, of course, requires no guide for finding any tool in the place, but when this man happens to be sick for a day or so, there is apt to be confusion until some one else gets the run of the tools. So that while it is unnecessary for the regular man to have any chart, nevertheless, it is a good thing to have in the tool room, in such emergencies. This can be arranged in any of the approved styles, probably by dividing the shelves into sections, and locating each tool in its correct section, thus having a record to which any one can refer. If possible, it should be made a point to arrange the shelves so that all the tools can be seen from a standing position, or, at least, without standing on your head to see what is on them, and this can be done ordinarily in the case of small tools, by inclining the shelves something as shown in the sketch of the shelves mentioned before. As to "checks" for tools, that is probably the best method in shops of any size, and it is also a good plan to have "a day of reckoning" every week, Saturday preferably, so as to know just where the tools are, and how many are being used. This would also help the men using the tools, as they would not lose track of them as they sometimes do, but would either return or give account of every tool charged to them, and start the week afresh.

By giving account, I simply mean they would be either using the tool or else could return it, in either case knowing just where it was. I do not suppose Mr. Stedman referred to the question as to how far the tool room should control the tools, such as lathe tools and the like, and so this need not be discussed, merely leaving it by saying that in large shops, or shops which have tools enough to keep a man on a griding machine, when not doing other work (if not all the time), it pays to have the lathe tools ground to a template, or by one man *who knows how*. It saves time, steel, forging and grindstones,

as any careful observer can testify. I do not mean that it is an unmixed blessing—but it has ten good points to one bad one, in most cases. FRED H. COLVIN.

Throttling Slide-Valve Compounds.

Editor American Machinist:

In reading the interesting articles in the AMERICAN MACHINIST upon "Throttling and Automatic Engines," it may not be inappropriate to call attention to a large pair of throttling compound engines at work in the Lees Brook Mill at Oldham, England, which the writer saw there in 1888. These engines were a pair of tandem condensing compounds of about 1,100 horse power, with independent slide valves at each end of each cylinder. There were no steam jackets, but the cylinders were heavily clothed with about 4 inches of asbestos. Each high and low pressure cylinder was 24 inches and 48 inches diameter, respectively; stroke 6 feet; speed 35 revolutions; boiler pressure 100 pounds; the valves were adjusted to cut off at about $\frac{45}{100}$ of stroke. The governor, a huge ball governor standing about 9 feet high, was driven by gearing from the main shaft, and controlled a throttle valve in steam pipe beneath the floor. The coal consumption of the plant was stated to be about 2 pounds of coal per indicated horse-power per hour. The condensing water was artificially cooled by a series of small ponds built of masonry near the mill.

In Cincinnati, the firm of Houston, Stanwood & Gamble have recently installed for electric lighting a non-condensing slide-valve compound engine controlled by a throttling governor. Diagrams from this engine are submitted for inspection. This engine, of the cross-compound type, was designed to develop 40 indicated horse-power with 80, and 50 indicated horse-power with 100 pounds of steam; it was expected to develop under these conditions as good economy as a Corliss engine; as yet no careful test has been conducted, but the fuel consumption has been quite satisfactory.

The cylinders are $7\frac{1}{2}$ inches and $11\frac{3}{8}$ inches diameter, respectively, 14 inches stroke, speed 200 revolutions, piston speed 466 feet per minute. No diagrams with full load have been taken, although the engine has been worked to over 50 horse-power. The diagrams shown illustrate how well a throttling engine properly proportioned behaves with light loads; one set indicates $17\frac{3}{10}$, the other $37\frac{4}{10}$ horse-power. The loads are quite evenly divided, thus, when indicating $17\frac{3}{10}$ horse-power, the low-pressure cylinder developed $7\frac{7}{10}$, the high-pressure cylinder $9\frac{1}{2}$ horse-power; when developing $37\frac{4}{10}$ horse power, the low-pressure cylinder shows $19\frac{4}{10}$, and the high-pressure 18 horse-power. The maximum strains under these conditions are also evenly distributed; with the lighter load the maximum total pressure on low-pressure piston is 1,500 pounds, on high-pressure piston 1,474 pounds; with heavier load, the low-pressure piston carries 2,800 pounds, the high-pressure piston 2,530 pounds.

The range of temperature in each cylinder is as follows, when developing $17\frac{3}{10}$ horse-power, the fluctuation in low pressure cylinder was 48°, in high-pressure cylinder 38°; with $37\frac{4}{10}$ horse-power the fluctuation was 58° in low-pressure cylinder and 53° in high-pressure cylinder.

The steam consumption by card is as follows:

Horse-power indicated	$17\frac{3}{10}$	$37\frac{4}{10}$
Steam per I. H. P. per hour per card at cut-off H. P. cylinder	28½ lbs.	20.1 lbs.
Steam per I. H. P. per hour per card at release H. P. cylinder	31 lbs.	21.1 lbs.
Steam per I. H. P. per hour per card at cut-off L. P. cylinder	28 lbs.	20.1 lbs.
Steam per I. H. P. per hour per card at release L. P. cylinder	32 lbs.	22.2 lbs.

The high-pressure cylinder is steam jacketed, the condensed steam passing on to the low-pressure cylinder. The engine has a heavy fly wheel which absorbs sudden variations of load, and a large Pickering governor which controls speed between narrow limits, as the large valve has but a small travel to contract a relatively large area for passage of steam.

The engine drives a single card dynamo rated at 25 kilo-watt capacity, it has driven it for four hours with a load of nearly 32 kilo watts.

The performance of the engine leads the manufacturers to believe that with 120 pounds of steam and carefully designed valve gear a slide-valve compound can be made to give excellent results, especially when called upon to carry light and heavy loads. JAMES B STANWOOD.

Cincinnati, O.

Improving the Fire Engine.

Editor American Machinist:

Permit me to add a few words to what has been recently said on the subject of improving the fire engine. The electric system suggested by Mr. J. Neuert, in your issue of May 24th, seems to be feasible enough. The most serious objection to it would probably be that electric connections are so frequently interrupted when a conflagration is going on. I have but little faith in the use of compressed air for fire service, especially as a substitute for horses, and therefore think that Mr. Frank Richards' first impressions, as stated in your last issue, were the best. I cannot see how an engine such as he describes, with an air receiver of sufficient capacity and strength to furnish the requisite power, could be made with less than half the weight of an ordinary steam fire engine. If, however, this could be done, there are possibly other reasons why compressed air may not come into general use as a means of distributing power in cities.

The facilities for handling air in a compressed condition are, of course, well understood, and especially those connected with mining and tunneling operations.

The facility with which it escapes, unemployed, is often a mystery, even to those who give it close attention.

I am not going to attempt to enlighten any one on this subject, but by simply alluding to this and other difficulties, possibly prevent some enthusiastic inventor from getting compressed air on the brain.

I have always thought that compressed air escapes more readily than steam through defective rings and packing joints, but have never made experiments to show this. Perhaps the condensed vapor in the case of steam forms a better filler, as well as a better lubricant, than cold water or no water at all. But to say nothing of this, there must be a great loss of energy from the dissipation of the heat generated by the compression of the air, and the consequent increase of pressure that follows. I notice, however, that Mr. Richards' recent paper read at the Montreal meeting of the A. S. M. E. shows the discrepancy between the power expended in compressing and that realized from the air to be less than is generally supposed.

Another objection might be urged against the use of a system of underground air pipes for supplying fire engines with power. This would be the possibility of derangement in the system which might render the entire fire department helpless. Of course, such an occurrence may be guarded against in the same way the water supply is assured, that is, by the use of cut off valves and auxiliary branches. Yet it looks like putting too many eggs in one basket, to employ a sort of twin system, either of which might, by accident, render the whole inoperative at a time when most needed.

"QUIRK."

Milling Machines.

Editor American Machinist:

There is nothing "surprising" about the "efficiency" of the Brown & Sharpe milling machine No. 24, Lipe's patent. The largest step of the cone, according to the description of Horace L. Arnold, in the AMERICAN MACHINIST, is "only" 11 inches diameter, and the worm-gear is "only" 6 inches in diameter, but, please notice that this worm-gear has 40 teeth. I do not know what the largest diameter of cutter used in this machine is, but, for comparison, I will assume it to be 7 inches, as this is the largest cutter used in a machine now used in our shop, and which is of much better design than the average milling machine.

The slowest number of revolutions per minute of a 7-inch diameter cutter would be about 19, and this would mean that the worm would make 760 revolutions per minute, and, as the driving cone is on the same shaft as the worm, it follows that the belt when running on the largest step of the cone (which is "only" 11 inches diameter) where it would transmit the least power, would move 2,185 feet per minute.

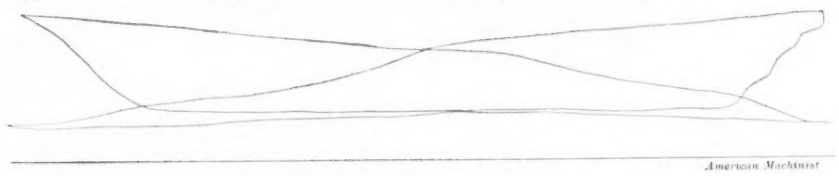
Now, on this other machine mentioned above, which is a good machine as milling machines go, and is, as said before, better than the average milling machine, being "strongly back-geared," the belt speed for a 7-inch diameter cutter is only about 655 feet per minute. It is, therefore, evident that the driving power of the Lipe machine is about $3\frac{1}{4}$ times as much as this other machine, which has the same size cone, and is therefore a fair comparison.

But, more than all this, the feed in the Lipe machine is taken directly from the cone shaft (instead of from the spindle, as is usual in most other machines). The Lipe feed belt, therefore, runs about 40 times as fast as the ordinary milling machine feed belt on same size machine; slow running feed belts is the weak point on 99 milling machines out of every 100. I have advocated for six or seven years that the feed on the common type of back-geared milling machines should be taken from the cone, instead of the spindle so that the feed belt would not be slowed down when the back gears are in use, and about five years ago I persuaded one builder to make a feed after this idea, and, although it has been acknowledged and adopted by at least two well known builders of milling machines since that time, there are still some alleged milling machine experts that protest that it is not right; that the feed ought to be slowed down when the back gears are used, the principal reason given being that the feed on an engine lathe is slowed down when the back gears are in, and, therefore, it ought to be the same on a milling machine. Suppose Mr. Lipe had argued that as no one had ever driven an engine lathe with a worm gear, it would not, therefore, be a good thing to drive a milling machine in that manner.

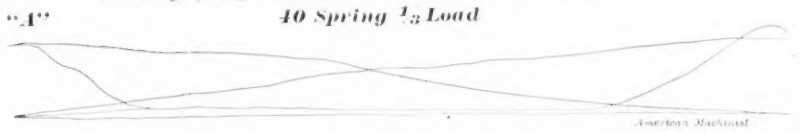
The only surprising thing about this matter is that anyone should be surprised that the Lipe machine has efficiency, and that the efficiency should be expressed in terms of total weight of the machine.

GREASER.

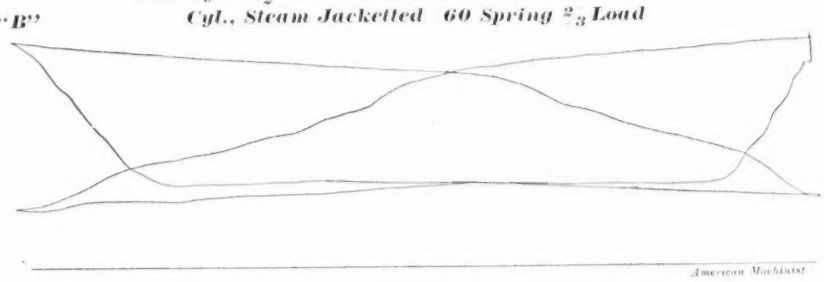
H.P. Cyl. $7\frac{1}{2}''$ x 14" 200 Revs. Boiler Press., 55 lbs.
"A" Cyl., Steam Jacketted 60 Spring $\frac{1}{3}$ Load



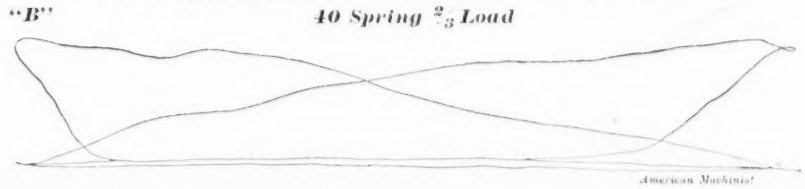
L.P. Cyl., $11\frac{3}{8}''$ x 14" 200 Revs. Boiler Press., 55 lbs.
"A" 40 Spring $\frac{1}{3}$ Load



H.P. Cyl. $7\frac{1}{2}''$ x 14" 200 Revs. Boiler Press., 80 lbs.
"B" Cyl., Steam Jacketted 60 Spring $\frac{2}{3}$ Load



L.P. Cyl., $11\frac{3}{8}''$ x 14" 200 Revs. Boiler Press., 80 lbs.
"B" 40 Spring $\frac{2}{3}$ Load



Removing Tightly Fitted Pieces.

Editor American Machinist:

I have read both articles on "Removing a Crank Disk" and see nothing improbable in the first article.

I have removed large pulleys and water-wheels from shafts that were on so tight that 1½ inch rods would break without starting them. By building a fire under the hub, and keeping the shaft as cool as possible by wrapping it with sheet wood pulp and keeping the pulp wet I would get a strain on the rods and then build the fire and wait for the pulley to start, and it would always start with a jump. I don't think they were shrunk on fits.

I have also removed a flange 36 inches diameter, fit 4 inches long, chased out four threads to the inch, and screwed on to a 5½-inch shaft that was on so tight that I could not remove it with levers. I mounted the shaft in V-blocks, wrapped it with wood-pulp, built a fire under flange and revolved it in the fire; when I thought it hot enough I applied the levers and started it.

I have removed quite a number of small things that were shrunk fits, by heating them in a fire and driving them off.

I know of three brass jackets, 15 inches inside diameter and about 90 inches long, that were jacked and shrunk (combined) onto a cast iron roll, being taken off by getting a strain on them with rods, and then applying a jet of steam to the jacket.

The fit was a slight taper.

W. C. DENNIS.

Later investigation into the matter of the assassination of M. Carnot indicates that the deed was instigated by anarchists and performed by an anarchist. By such deeds anarchists seek to show the uselessness of law; instead of which they give added proof of its absolute necessity.

The suggestion has been made that anarchists should be regarded as insane, and should be treated as insane, *i. e.*, confined where they can do no harm, before they have a chance to do harm, and the suggestion seems a good one.

A Baltimore paper in giving an account of a side wheel steamer run by gasoline says the engine is always running except when purposely stopped. An engine which will do this is certainly very greatly to be desired. The habit that most engines have of occasionally stopping when not purposely stopped sometimes produces very serious results.

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Manufacturer vs. Monopolist.

Two weeks ago we called attention to the essential difference between purely manufacturing operations and monopoly, a difference which we think is much too often overlooked in these days, even by manufacturers themselves, who would seem to be especially interested in maintaining the distinction.

It is quite certain that much of the complaint and criticism directed against manufacturers is so directed simply because proper distinctions are not made between manufacturers, on the one hand, and monopolies, trusts, etc., on the other.

It will, we think, be to the advantage of manufacturers if they insist upon distinctions between themselves and monopolists, calling attention to the indisputable fact that in lines of manufacture in which competition is open and free there is on the average no more, in the form of profits, than what would be generally agreed to be fair salaries for the owners in return for work done by them, together with interest on the capital invested at ruling rates. We do not mean to say there are no manufacturing establishments unbenefitted by monopoly, that do better than this, but we do mean to say that where there is one that does better, there are a dozen that do not do so well, and that the average, taking all establishments, times and seasons, do not do better than they ought to do, if as well as they ought.

But where combinations, trusts, etc., come in their profits grow inordinately, not only at the expense of the people, but to the prejudice of legitimate manufacturers, who, by the unthinking, are classed with them.

It is grossly unfair, for instance, to class a builder of steam engines or of machine tools with a member of the binder-twine trust, the sugar trust, the white-lead trust, or the steel-rail trust.

In the first named lines of manufacture competition is practically open and free to all, and it can, we think, be conclusively shown that prices of engines and tools are, upon the average, quite as low as they ought to be, to say the least, and dozens of other lines of manufacture might be mentioned in the same class, where most of those engaged in them have to strain every nerve and exercise to the full every faculty in order to keep their heads above water.

And while it is true that members of the trusts named are manufacturers, they are also something else besides and it is as monopolists, rather than as manufacturers, that they make their money.

In the case of a manufacturer of binding twine, for instance, it has been shown that the trust has capitalized its business at a sum very much in excess of the actual capital invested, and has thus, by procuring specially favorable legislation, been enabled to fleece the farmers and stand in the way of manufacturers of harvesting machinery, paying dividends amounting to several hundred per cent. upon the actual values represented by its properties. Other trusts have done much the same. Legitimate manufacturers make a mistake when they allow themselves to be classed with such operators, and they should take pains to draw distinctions, and emphasize them upon every possible occasion. The interests of the two classes are entirely distinct and even antagonistic, and yet, too often when actions of trusts and combines are criticised, manufacturers take the criticism to themselves, instead of calling attention to the plain fact that trust and combine operations are one thing, and legitimate manufacturing an entirely different thing.

As we have before pointed out, manufacturers of engines, machine tools, woodworking machinery, etc., cannot hope ever to be able to form an effective combination, but they must, as manufacturers and as citizens, pay tribute to the trusts and combines that are formed. It will be well for manufacturers always to be careful to distinguish between their own interests and those of monopolists, and to insist that legislators and all others shall do the same.

Long and Short Connections to Indicators.

Last year we published an article by Edward J. Willis in which he gave the results of tests made with four indicators, all located with equal length of connecting pipe and, in other respects, similarly arranged. Diagrams were taken simultaneously with these four instruments, the result being such as to show that any one of the indicators could not be expected to work "twice alike," but that the error or variation was not large.

Later on, in continuance of his experiments, Mr. Willis made a very careful test of the effect of a pipe connection to the indicator, of considerable length. He found practically no difference in the diagram from the closely connected instrument, and the one at the end of the pipe. These diagrams were from a high-speed engine, and it was suggested by several correspondents that the difference would have been plain with a slower speed.

Perhaps it was this criticism that induced Mr. Willis to continue his experiments, as published in our issue of June 7th, the engine in this case being a 13-inch by 18 inch, at a speed of 90 to 130 revolutions. As our readers remember, he again found substantially no difference between the diagrams, or at least no greater difference than he had found in his original experiment with the four indicators connected precisely alike. In criticising his last experiment *Power* says:

We hardly think that this is a demonstration of the harmlessness of the long and indirect connection. The four feet of half-inch pipe and connections used would add over four per cent. to the clearance of the engine, and would affect, in every way that clearance can affect a diagram, the direct as well as the indirectly connected instrument. When the disastrous effects of clearance are considered, the impropriety of adding largely to that of an engine under test must be apparent.

And then our contemporary proceeds with criticism in its usual fair and courteous manner, but all the time with the four per cent. clearance as a text. The only weak point in its argument is that it is constructed on false premises. By a mistake, natural enough, but fatal to its conclusions, *Power* makes the added clearance due to the four feet of pipe four per cent. instead of *four tenths of one per cent.*, which it really is, very nearly.

In relation to the whole matter, it may be well enough to repeat what we have before said in substance, viz., that Mr. Willis is not trying to prove any pet theory, but simply to determine facts. Neither does he recommend the use of longer pipes than are found necessary, nor claim that his experiments are conclusive any further than they relate to the particular cases which he investigates. Others can draw their own conclusions, and experiment for themselves. We may add, however, that in any particular case, to arrive at reasonably satisfactory conclusions, the diagrams should be taken simultaneously and with something of the care employed by Mr. Willis, who, we may add is not using the indicator "as a plaything," but with a care and precision of detail which we believe has never been exceeded.

A Many-sided Man.

Assistant Secretary of the Navy William McAdoo is quoted as saying in the course of an address delivered at the opening of the "War College," at Newport, that

The modern naval officer, especially in a navy like ours, must be a many-sided man, versed in everything from steam to electricity, from a practical knowledge of lubricating oil to a complete mastery of every mechanical science; able to make and run an engine, build a gun, forge armor, construct ships, manage a navy yard, settle disputes between sailors, discuss learnedly questions between the staff and line, adjudicate questions of military etiquette, and, finally, expound and carry into practice the most profound secrets of international law, and, to cap it all, be discreet and wise at home, a diplomat abroad, and be able to cite even in his dreams, every sentence of the navy regulations, and never forget for a moment that he is an American citizen and bears intimate responsibilities and relationships to all our people.

At the first reading it seems as though it were intended to say that the body of naval officers taken altogether must be capable of doing all these things; but the language implies that the intention was to set forth the vast amount of knowledge that must be possessed by an individual officer, and, therefore, the necessity for a new college in which to educate him.

If this is what it really means, then, with all due respect we must say that nothing could be more absurd.

Upon the assumption that the man who commands a naval vessel or fleet must know everything pertaining to the construction and navigation of naval vessels, it is evident that some important departments of human knowledge have been omitted from the list, and, that in addition to those mentioned, the naval officer should thoroughly understand astronomy, be capable of making calculations for a nautical almanac, and constructing sextants, chronometers, dynamos, lieutenants' uniforms and sailors' socks.

We have taken occasion before this to criticise one sided expert testimony in mechanical matters, especially when it related to patent suits, our ground being that an expert retained *ex parte* would twist facts to favor his client. It seems to be just the same in all other matters. As, for example, some time last year, during the excitement of a political campaign, it was claimed that an official was a defaulter to the county in quite a large sum. An expert accountant was set in the regular way to examine the official's accounts, and he pronounced them quite correct. Not satisfied with this, one of the political parties put an accountant at the job, and he found them all wrong. Then the two parties selected each an expert to make the examination, the result being that one found the accounts wrong and the other found them right. At length the matter having come before a judge, he put the accounts into the hands of a firm of unprejudiced accountants, and everything was found to be as it should be. Now, it has always been our contention that in patent cases the court should put an expert at work on the case instead of leaving it to be misrepresented in every possible way by opposing experts, and the case just cited seems to fortify our position.

The latest scheme in vessel propulsion is a variation of the fin plan, and the inventor claims to have made great speed with a small model. The principal reason for this high-rate speed being, as he alleges, the fact that while the engine has a stroke of 1½ inches, the fins have a stroke of only 1⅛ inches, thus being "within the crank-pin," which is claimed to be a "great point in the patent." Probably it is the greatest point in the patent, but if we were in the inventor's place we would not confess it.

Literary Notes.

ART OF COPPERSMITHING. A practical treatise on working sheet copper into all forms. By John Fuller, Sr.

This book will, undoubtedly, be appreciated by all interested in coppersmithing, and those who wish to acquire proficiency in the art of copper work. The book is written by a practical man for practical men. The progress of the work is shown in all its stages; the tools and appliances required are described and illustrated, and instructions given in laying out patterns. The smallest details receive their share of attention, so as to make the book as valuable as possible for the beginner in this handicraft. The illustrations, of which there are 475, are fine, and form a special feature of the book, and are of great aid to make the context of the text clear. The book contains 327 pages, including the index; pages, 9½x6 inches. It is published by David Williams, 96–102 Reade street, New York. Price, $3.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(316) L. H., Union Hill, N. J., writes: I would like to know the date of your issue in which the series of articles relating to laying out gears was commenced? *A.*—Odontics, or the Theory and Practice of the Teeth of Gears, by G. B. Grant, April 17, 1890. We cannot supply these numbers.

(317) A. B., ——Mich., asks: What publications can you recommend giving information on setting up engines and boilers, etc.? *A.*—Literature on this subject is scarce; probably "How to Run Engines and Boilers," by E. P. Watson, will be of service to you. 2. Who are the manufacturers of portable keyseating machines? *A.*—Write to any builders of machine tools; the addresses of some of these are given in our advertising columns.

(318) A. L. K., Reading, Pa., writes: Please advise me of the most simple and practical way of testing the blow of a foot-power hammer? *A.*—We have no records of tests of this kind, and cannot give you the information desired. We should be pleased to hear from our readers on the subject. 2. How many tons pressure will it require to cut off a bar of common iron 1 by 6 inches under a machine with the top shoe blade moving vertically, with dimensions, etc., as per sketch? *A.*—About 122 tons.

(319) E. B. R., Wellsville, N. Y., asks: Are gas engines practicable for running dynamos? *A.*—Yes. 2. Are there any gas engines of 80 horse-power suitable for electric lighting? *A.*—Yes. 3. How much coal per horse power per hour is required for slide-valve engines, and how much for the Corliss engine? *A.*—That depends upon the size and type of engine; 10 pounds of coal per horse power per hour or more may be required for small non-condensing engines, and this quantity may be reduced to 2 pounds for large condensing engines.

(320) T., Orangeburg, S. C., writes: I have a motor using 480 gallons of water per hour. I wish to discharge it into cistern. The pipe is 600 feet long. What size pipe will it take and how high above the end of the pipe must the motor be placed? *A.*—For a velocity of 3 feet per second you will need a pipe $\frac{1}{10}$ foot diameter. The motor must be set high enough so as to give a head of 25 feet. 2. How high above the end must the motor be when the pipe is 1¼ inch diameter? *A.*—The head should be 10 8 feet. 3. How high should the motor be for an 1½ inch pipe? *A.*—4.5 feet head. 4. What should be the diameter of the pipe with a head of 1 foot? *A.*—2 inches.

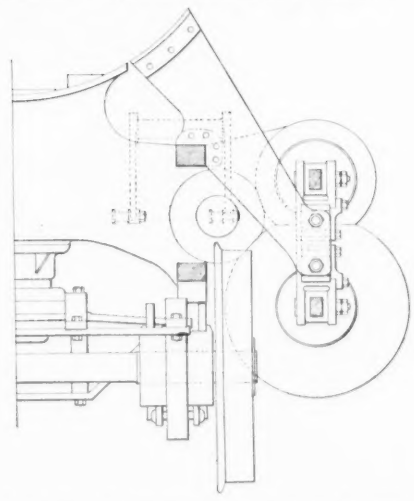
(321) A. M. Colfax, Wash., writes: I want to drop a weight of 1,000 or 2,000 pounds through a distance 25 or 50 feet upon a catrage of nitro glycerine, which may be on a bed of rocks. What metal would be best to withstand the shock, cast iron, malleable iron, or steel? Also give price per pound for such material. *A.*—We should use steel. For price, write to any manufacturer of steel, the addresses of some of these are given in our advertising columns. In writing to the manufacturers state the purpose for which the steel is to be used. 2. Is it probable that electric heat will be wanted for the power? *A.*—We do not understand your question.

(322) K., Buffalo, N. Y., writes: Please give size of engine and the principal dimensions of boiler carrying a steam pressure of 75 pounds per square inch, suitable for a boat 25 feet long, 6½ feet wide, and 3 feet deep. The boat is to run 10 miles per hour. If the given steam pressure is too low, what should it be? *A.*—The power required to drive this boat depends much on the fineness of the lines, of which we know nothing, and the speed is high for so small a boat. Under these conditions we can give an approximation only. Engine, non condensing, cylinder 4½ inches diameter, 5 inches stroke, 400 revolutions per minute. We should select a water tube boiler having a grate surface of 4 square feet and a heating surface of 120 square feet. Steam pressure 150 pounds per square inch. 2. Will it be cheaper to use kerosene oil at six cents per gallon than coal at the present rate? *A.*—No. 3. What diameter and pitch of propeller will I need? *A.*—Diameter of propeller 20 inches; pitch, 36 inches. 4. What license will I need to run this boat? *A.*—You will require an engineer's and pilot's license, provided the boat is to run in waters controlled by U. S. Government.

(323) E. E. T., Milton, Pa., writes: Please give me some information in regard to enameling. How is it made, and of what? How hot should the oven be, and how long should an article remain in it? *A.*—Enamel is a vitreous substance of glass, opaque or transparent, and variously colored, applied as a coating on a surface of metal or of porcelain for purposes of decoration. It consists of easily fusible salts, such as the silicates and borates of sodium, potassium, lead, etc., to which various earths and metallic oxides are added to give the desired colors. These enamels are now prepared in the form of sticks, like sealing wax, and for use are pulverized and applied to the surface either dry or moistened to form a paste. The object to be enameled is then exposed to a moderate temperature in a muffle, and the vitreous substance becomes sufficiently fluid to form a brilliant and adhesive coating. The exact temperature to which the object is to be exposed depends on the class of work to be enameled. There are various operations of enameling, and require skillful manipulations, a knowledge of which can only be obtained by long practice.

(324) A. P., ——, Pa., writes: Please answer the following questions: I give you all the data that was given to me. What should be the size of a steam cylinder for a blowing engine with air cylinder 30 inches diameter and 24 inches stroke? The speed is to be 50 revolutions per minute. The air is to agitate a liquid weighing 75 pounds per cubic foot; its depth is from 17 to 18 feet in a tank 9 feet in diameter. The air enters through a 9 inch pipe at the top of tank, and is distributed through smaller pipes at the bottom. 2. What steam pressure should be used? 2. What should be the diameter of steam and exhaust pipes? 4. What should be the weight of each fly-wheel; two are to be used? And how many square feet of heating surface will be required for the boiler? *A.*—Steam cylinder, 17 inches diameter; mean effective steam pressure, 50 pounds per square inch. Here we have assumed that the pistons of air and steam cylinders are fastened to the same rod. Diameter of steam pipe, 1¾ inches; diameter of exhaust pipe, 3¾ inches. Fly-wheels, 12 feet diameter, 7,500 pounds each. Heating surface will depend on the type of boiler; for a tubular boiler about 1 050 square feet of heating surface will be required.

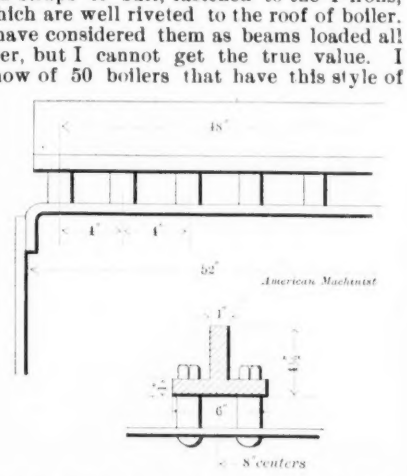
(325) O. E. E., York, Neb., writes: I have noticed in one of your issues a valve design, the invention of Mr. J. Haug, which called to my mind an old design of mine, of which I inclose a tracing giving a sectional elevation, and an end elevation as applied to a locomotive taken back of the guide yoke. You do not say the design of valve is patented, but, as it seems to be considered



an invention, I presume it is patented. If so, would I be prevented from applying my own design should I desire to do so? Please give me an opinion. I may say that I first designed this valve for a vertical stationary engine of the cross compound type, some time in the winter of 1888 and 1889. *A.*—The valve to which you refer is patented. We cannot give an opinion as we have not seen the patent specifications; in fact, no one but a first class patent lawyer can give you reliable information on the subject.

(326) X. Y., ——, asks: If timber weighing 39½ pounds per cubic foot is immersed in water a great length of time, how much will its buoyancy be decreased, caused by water soaking? *A.*—Wood will lose its buoyancy when immersed in water, but we have no data from which we can determine how much of the buoyancy will be lost in a given time. 2. Is there any way to prevent this absorption, as by treating with pitch, creosote, etc.? What timber would be best for use as buoyancy on floating discharge pipes in a river, considering cost, durability, etc.? *A.*—Probably the best treatment of timber to adopt for the prevention of decay and absorption of water is to force dead oil into the timber. This process is called creosoting. The timber and the dead oil are inclosed in a large tank and subjected to a pressure varying between 100 to 200 pounds per square inch, at a temperature at 120° Fahr., for a period of about twelve hours. From eight to twelve pounds of oil are thus injected into each cubic foot of wood. Hemlock or pine, whichever is the cheapest in your locality, will be suitable for your purpose. Before the timber is subjected to this process it should be well seasoned, otherwise the sap will prevent the thorough penetration of the oil, and cause the greater part of the wood to rot, although its firm outer shell gives it a deceptive appearance of strength. The best timber-preserving processes are practically useless unless thoroughly well done. If the gain of durability will not warrant the expenditure of time and money required for this, it is more economical to use the wood in its natural state. The creosote protects the spickes from rusting which may be an advantage in your case. It renders the wood stiffer and slightly more brittle. Its smell excludes its use from dwellings.

(327) B. B., Philadelphia, Pa., writes: Please inform me how to compute the strength of a ⊥ crown bar, as shown in the accompanying sketch. We have on each bar four sling stays with one inch bolts and straps to suit, fastened to the T irons, which are well riveted to the roof of boiler. I have considered them as beams loaded all over, but I cannot get the true value. I know of 50 boilers that have this style of



crown bars and none have shown signs of weakness, therefore, I have concluded that I am in error. *A.*—For all practical purposes, we may consider this crown bar uniformly loaded and supported at points 48 inches apart. To find the load which this bar can support, we use the following formula:

$$W = 8 \times \frac{S \times I}{l \times c}, \qquad (1)$$

in which W = load in pounds, S = stress per square inch on fibers most remote from the neutral surface, for which we may take a value of 12,000 pounds, I moment of inertia, l = length of beam in inches (48 inches in this case,) and c = distance in inches of most remote fiber from neutral surface, or, we may say, the distance from the upper edge of ⊥ to the center of gravity of section, which is 3 16 inches in this case. The moment of inertia for a ⊥ section is found by the following formula:

$$I = \frac{b \times d^3 - (b - t^1) \times (d - t)^3}{3} - A \times c^2,$$

in which b = breadth of base of ⊥ bar in inches, d = depth in inches, t = thickness of flange, t^1 = thickness of web, A = area of section in square inches, and c = as given above. Substituting for the letters their values we have

$$I = \frac{6 \times 4.5^3 - (6 - 1) \times (4.5 - 1)^3}{3} - 9.5 \times 3.16^2$$

$$= \frac{546.75 - 5 \times 3.5^3}{3} - 94.863$$

$$= \frac{546.75 - 214.375}{3} - 94.863$$

$$= 110.791 - 94.863 = 15.928,$$

Now substituting for the letters in formula (1) their values we have

$$W = 8 \times \frac{12,000 \times 15.928}{48 \times 3.16} = 10\,080 \text{ pounds}$$

for the load which the bar can safely carry. The crown bars, according to sketch, are placed 8 inches from center to center, and the fire box is 52 inches wide and the steam pressure is 180 pounds per square inch; hence the total load on each crown bar will be

$$8 \times 52 \times 180 = 74\,880 \text{ pounds;}$$

but each crown bar can carry only 10,080 pounds; hence we have 74 880 — 10,080 = 64,800 pounds which must be supported by the braces. The tensile stress in these braces should not exceed 6 000 per square inch, consequently the aggregate cross sectional of the braces must be $\frac{64.800}{6,000} = 10.8$ square inches, and if there are four braces to each bar, then the cross sectional area of each brace must be $\frac{10.8}{4} = 2.7$ square inches. Here we have not taken into account the pressure which is resisted by the rivets through flange of crown and side sheets. In our opinion, the design of the crown bar can be much improved; the ends of the bar should be bent downward so as to rest on the edges of the side sheets, this will relieve the junction between flange and crown sheet of much unnecessary stress and make the whole safer.

A mechanical contemporary says a square inch of section is much smaller than one inch square. We wonder just how much smaller.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—
Emery, emery wheels, grinding machines, knife powders and sharpeners, paste and liquid polish, whetstones, etc., etc.; quick process and large stock. Customers annoyed by the delays due to long processes and small stock can get goods in a hurry by buying of the
Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

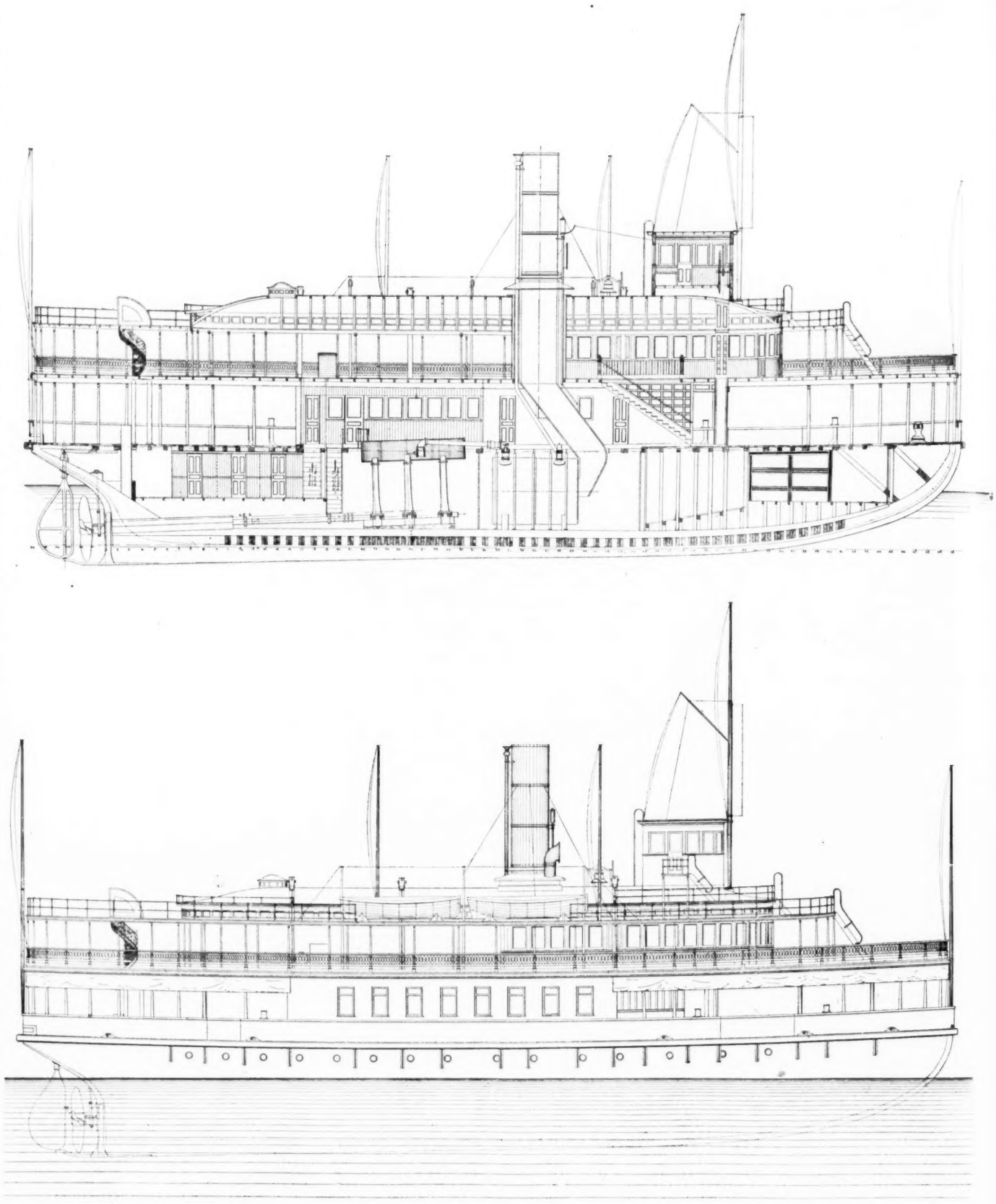
"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

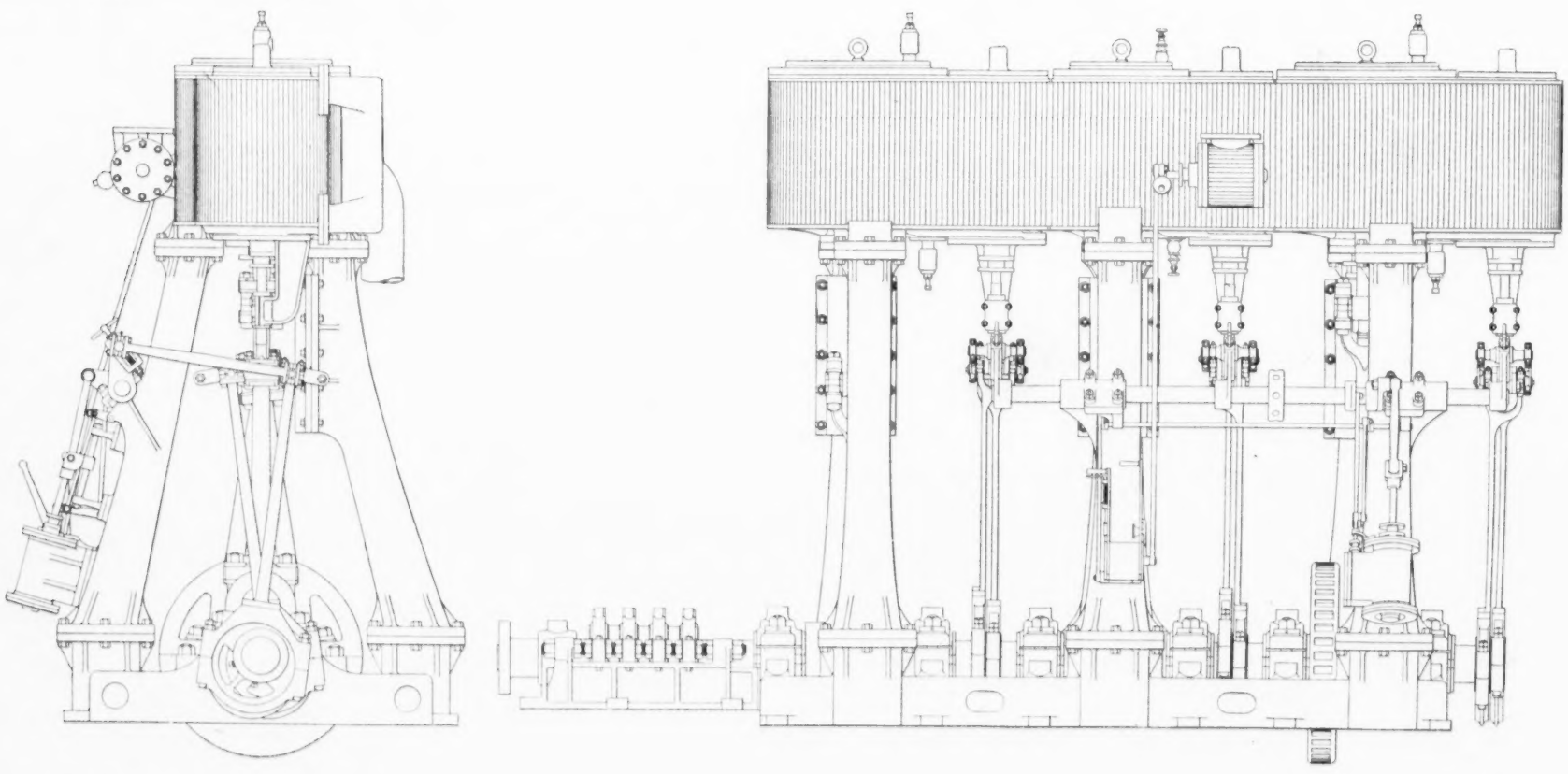
"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

Screw Ferry Steamer "Pleasure."

With this we give illustrations of engine, and several views of the handsome screw ferry steamer "Pleasure," recently added to the large fleet of excursion steamers in the service of the Belle Isle and Windsor Ferry Company. She is to run on the Detroit River, touching at Belle Isle, Windsor, and other summer resorts. The distance between stops being too short to obtain the full benefits of a triple-expansion engine, it was decided to adopt a three-cylinder compound engine, thereby retain

ing the smooth working of a triple-crank engine. The high-pressure cylinder is 24 inches diameter, and the two low-pressure cylinders are 34 inches diameter each, with a common stroke of 24 inches. The high-pressure cylinder is placed in the center so as to equalize pressures and passages. Each cylinder is fitted with relief valve, and a 3-inch starting valve is provided to admit live steam into both low-pressure cylinders. The engine is designed for a piston speed of 500 feet per minute. The ports in the high-pressure cylinder are $2\frac{1}{2}$ inches wide and 19 inches long, and both low-pressure cylinders have ports 3 inches wide and 26 inches long. The main steam pipe is 7 inches diameter, the receiver pipe is 8 inches diameter, and the exhaust pipes leading to condenser are each $9\frac{1}{2}$ inches diameter. The throttle valve is of the balanced cylindrical type, and fitted with suitable relief valve so as to work freely. All cylinders are fitted with valve chest liners of hard close-grained cast-iron, with diagonal bridges and ports 2 inches wide. The high pressure valve is 11 inches diameter, fitted with solid ring so as to be easily renewed, and the low-pressure valves are each 15 inches diameter, fitted with self-setting spring rings. The outside lap on the high pressure valve is $1\frac{3}{16}$ inches on top, and 1 inch on bottom, and $\frac{3}{16}$ inch inside lap on bottom; the low-pressure valves have $1\frac{9}{16}$ lap on top, and $1\frac{5}{8}$ inches on bottom, with an inside lap of $\frac{9}{16}$ inch on bottom. All valves have a travel of 5 inches, and are worked directly by the Stephenson double bar link motion, provided with adjustable cut-off arrangement. Steam is cut off at 0 75 stroke in high-pressure cylinder, and 0.65 stroke in low pressure cylinders when in full gear. All valve stems are of machinery steel $2\frac{1}{4}$ inches in diameter, and are guided by adjustable valve stem guides with brass bushings. The engine is provided with steam reversing gear, having a cylinder 8 inches diameter and 12 inches stroke operated by a differential valve motion under easy control of the engineer. The pistons are of cast iron 6 inches deep fitted with adjustable spring rings. The piston rods are of machine steel 4 inches diameter, secured to crossheads and pistons by tapered ends and nuts. The crossheads are of wrought-iron, with gudgeons and slippers forged on. The slippers are provided with brass gibs 10 inches wide and 14 inches deep. The connecting rods are of wrought iron 6 feet between centers, having the upper end forked to suit the crosshead pins, which are $4\frac{1}{2}$ inches diameter and 4 inches long. The upper ends are turned $3\frac{3}{4}$ inches diameter, and the lower ends $4\frac{3}{4}$ inches diameter. All bolts in connecting rods are of steel $1\frac{3}{4}$ inches diameter at the upper ends, and $2\frac{1}{4}$ inches

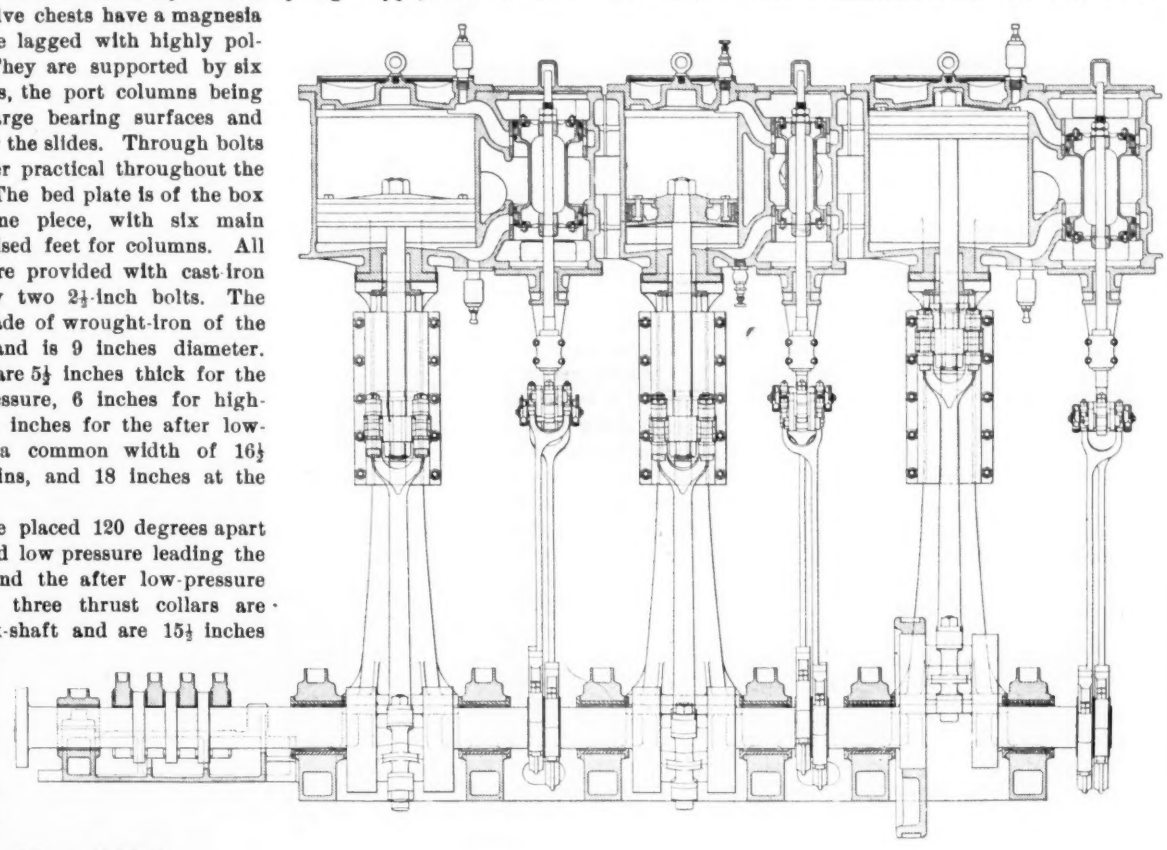


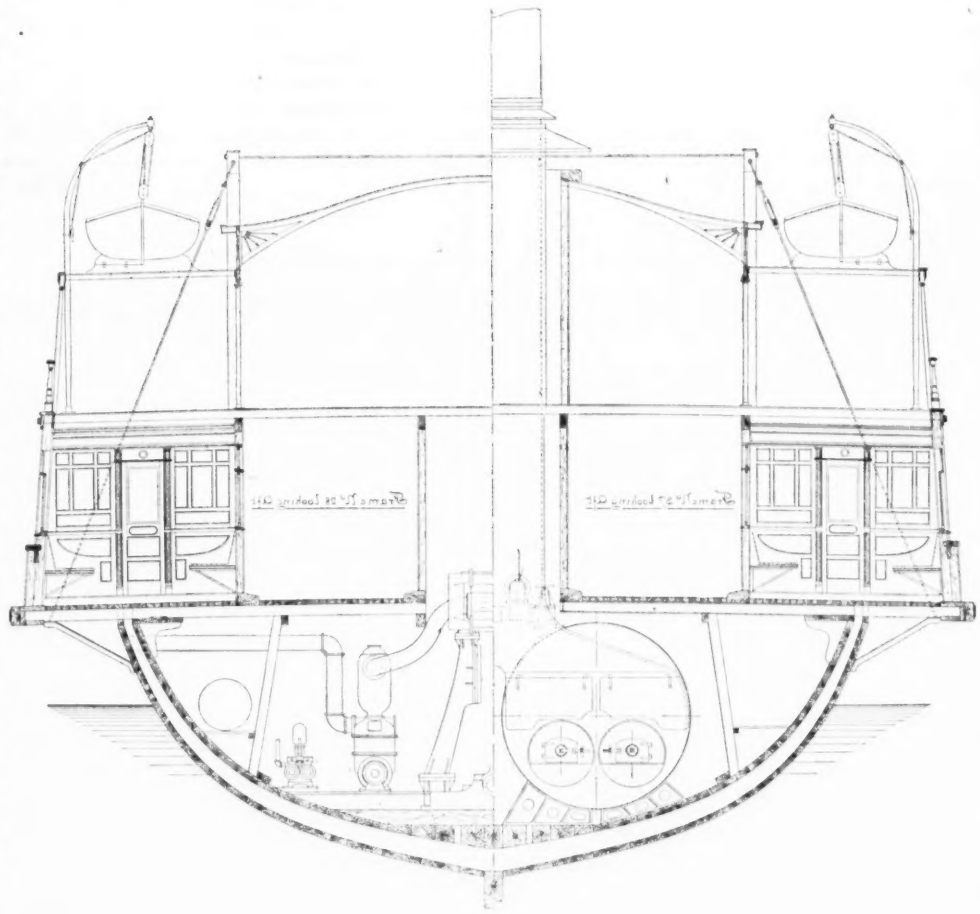


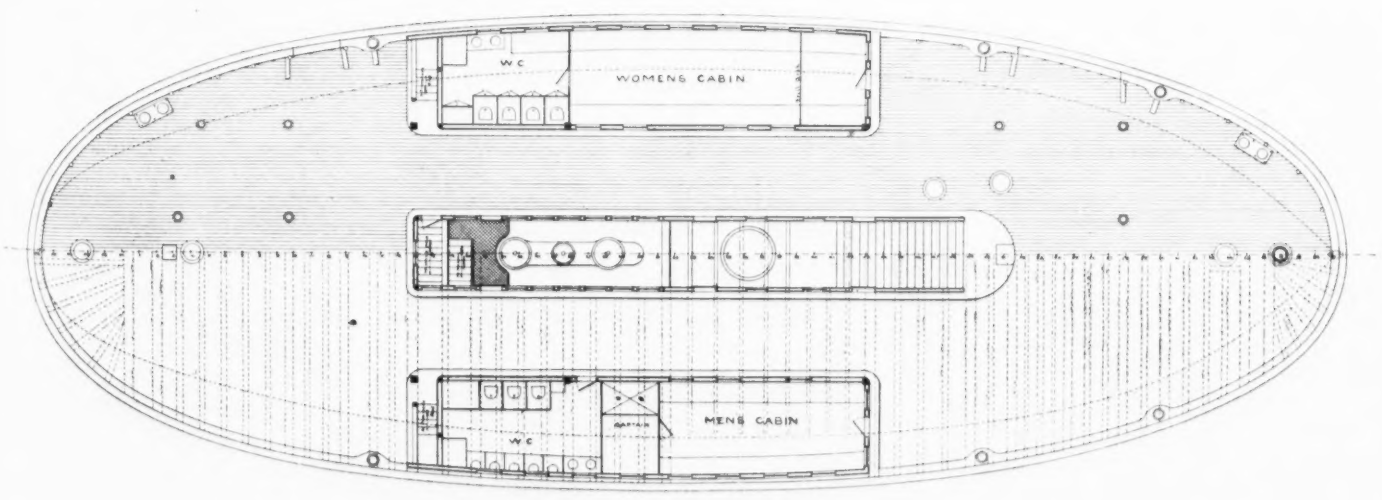
at the lower ends. The crank-pin brasses and all main journals are lined with magnolia anti-friction metal in strips. The cylinders and valve chests have a magnesia covering, and are lagged with highly polished cherry. They are supported by six cast-iron columns, the port columns being provided with large bearing surfaces and water jackets for the slides. Through bolts are used wherever practical throughout the whole engine. The bed plate is of the box type cast in one piece, with six main journals, and raised feet for columns. All main journals are provided with cast-iron caps secured by two 2½-inch bolts. The crank shaft is made of wrought-iron of the built-up type, and is 9 inches diameter. The crank arms are 5½ inches thick for the forward low-pressure, 6 inches for high-pressure, and 6½ inches for the after low-pressure, with a common width of 16½ inches at the pins, and 18 inches at the shaft.

The cranks are placed 120 degrees apart with the forward low pressure leading the high pressure, and the after low-pressure following. The three thrust collars are forged on crank-shaft and are 15½ inches diameter and 2½ inches thick. The thrust bearing is bolted to the bed plate and is of the horseshoe type, with four cast-iron columns with anti-friction metal facings adjustable by means of steel bolts and brass nuts. The collars are designed for a pressure of 50 pounds per square inch, and a line bearing 9 inches wide is cast on the thrust block to support the shaft, while a similar bearing supports the line shaft. The stern tube is of cast-iron 18 feet long, with an internal bearing at the forward end. The stern bearing is bolted to the stern post, and is of cast iron with a cap 20 inches long lined with lignum vitæ, and adjustable by means of a rod running through stern post. The line and propeller shafts are 9 inches diameter, and 9½ inches diameter at the bearings. The propeller wheel is 10 feet diameter and 13 feet pitch; it is of the cast-steel dovetail type, patented by the Dry Dock Iron Co., of Bay City, Mich.

Steam is furnished by two cylindrical return tubular boilers 10 feet in diameter and 12 feet long, designed for a working pressure of 135 pounds per square inch. Each boiler has two furnaces, 40 inches diameter and 9 feet 3 inches long, and 152 three-inch tubes, giving a total grate surface of 78 square feet, and a total heating surface of 2,554 square feet. The boilers were built by Wicks Bros., Saginaw, Mich.







All pumps are independent and were supplied by Dean Bros., of Indianapolis. The air pump is single-acting, steam cylinder 12 inches diameter, water cylinder 16 inches diameter, and a stroke of 12 inches. The feed pump is of the duplex, outside packed, plunger type, 10x6x12 inches. A suitable fire pump, bilge pump, and water service pump for tanks are also provided. The exhaust steam from all pumps passes through a feed-water heater, 20 inches diameter with fifty-two 1½-inch brass tubes six feet long. One of the features of the boiler room, which is commodious and well ventilated, is a hydraulic ash ejector, manufactured by the Detroit Dry Dock Co. By this labor-saving device the ashes are forced overboard by water under pressure from the deck pump.

The electric-light plant is located in the engine room, and consists of a 5x6 inch "Ideal" engine, with transmitter to save floor space, driving one of the Detroit Electrical Works' 110 volt generator, and 150 16 candle power light capacity. A marble switchboard with all necessary apparatus for controlling the plant is placed within easy reach of the engineer. There are 144 lights throughout the vessel, three and five-light clusters of ornamental brass being used in the sky-light and the cabins.

The principal dimensions of the vessel are:

Length over all, 140 feet.

Length on load water line, 127 feet 4 inches.

Breadth over guards, 51 feet 6 inches.

Beam molded, 39 feet 7 inches.

Beam on load water line, 36 feet.

Depth molded, 14 feet 5 inches.

Draught aft, 12 feet.

Draught forward, 9 feet.

The hull is built of white oak of very heavy dimensions throughout, and shaped forward so as to enable her to easily break through the ice encountered during winter service between the cities of Detroit and Windsor. Strong breast hooks are fitted forward and aft, and extra floors are provided both forward and under engine and boilers. The entire bottom and sides up to 2 feet above load water line are covered with steel plates fastened with countersunk rivet nails.

The rudder is of the balanced type, of iron, with a stock of 5½ inches diameter.

The frames are of oak molded 15 inches at throat, 5½ inches at top, sided 12 inches, spaced 22 inches between centers, and the planking and ceiling is of oak 3¾ inches in thickness.

Keel and keelsons are of oak 15x12 inches, and sister keelsons are 15x15 inches. The deck beams of oak are 7x7 inches and 7x12 inches, spaced 30 inches between centers. Steel I-beams 7x4x⅝ inches are placed over boilers.

Main deck stanchions are of white pine 6x6 inches; promenade deck stanchions 5x5 inches.

Fender strake is 6x11 inches, and main rail 3½x10 inches, of oak.

The vessel has three decks, and is capable of accommodating 2,000 passengers. The cabins are handsomely decorated throughout, and their appointments are luxurious and commodious; in fact, through the progressive character of the Ferry Company, with its energetic president and manager, Captain Walter E. Campbell, and able secretary and treasurer, H. W. Avery, a boat has been placed in service superior to all others previously built for the same company.

On the trial trip a speed of 16 miles per hour was attained, the engine running at the rate of 120 revolutions per minute, with 120 pounds of steam, and as a pressure of 135 pounds is allowed, a speed of 18 miles per hour can be obtained. We are informed that the engines worked highly satisfactory to all concerned, and reflect great credit on the builders of the hull and engine, F. W. Wheeler & Co., ship and engine builders, of West Bay City, Mich. The designs of hull and machinery were made by the constructing engineer of the company, Mr. S. Anderson.

Elevated Roads by Electricity.

A contract amounting to about $225,000 has been awarded the General Electric Company for the complete equipment of the Metropolitan elevated road of Chicago, with power plant, generators and motor cars. It is said that figures show a saving of about $200 000 a year in the operation of the road by electricity, as compared with steam locomotives.

The *Electrical Review* is authority for the statement that the substitution of electric power for locomotive, is talked of on the "L" roads of New York, and that the matter has gone as far as figuring on the cost of the equipment. The General Electric Company figures this at $8,000,000, which, it is said, the "L" road management considers too high.

A. E. Lippincott, well-known amongst N. A. S. E. men, has cultivated so much voice in his present business of convincing engineers that they need indicators, that his recent efforts to the end that his listeners should hear a lecture he was delivering before No. 39 of Brooklyn, called out the fire department. He will speak in lower tones hereafter. His explanation of the matter is that the flash light he was using for photographing caused all the trouble.

Twin-screw Steamship "North West."

The steamship "North West," which commenced a weekly service at the beginning of last month, is the first of the great lake steamers equipped for passenger service exclusively. Her route lies between Duluth, Minn., and Buffalo, N. Y. No freight being carried, her patrons will have the benefit of a rapid voyage, free from delays and annoyances accompanying the handling of freight. It is probably safe to say, that for speed, safety, comfort, luxurious appointments and sanitary arrangements, she is not surpassed by any steamer afloat. The vessel is built entirely of mild steel, and under the rules and inspection of the United States Standard Register for the highest class. The hull is divided into numerous water-tight compartments by transverse and longitudinal bulkheads, several of these extend to the upper spar deck without any doors or openings. An inner bottom extends from the collision bulkhead forward to the after peak bulkhead. The principal dimensions of the hull are: Length over all, 383 feet; length between perpendiculars, 360 feet; breadth, molded, 44 feet; depth, 26 feet; load draft, 14 feet; load displacement, 4 482 tons; tonnage, gross registered, 4,244 tons; tonnage, net registered, 2,340 tons; capacity of coal bunkers, 1,000 tons. The steamer can carry 442 cabin passengers; steerage passengers, 211; her crew numbers 147. She has twin screws, four blades each, diameter 13 feet; pitch, 18 feet. The two main engines are of the quadruple expansion type; diameter of high-pressure cylinder, 25 inches; first intermediate, 36 inches; second intermediate, 51½ inches; and low-pressure cylinder, 74 inches; stroke, 42 inches. Total indicated horse power, 7,000. Steam is furnished by 28 Belleville water-tube boilers, divided into three groups. They are designed to give sufficient steam to the main engines, and to the auxiliaries of 500 horse power more. The total grate surface is 812 square feet; heating surface, 25,760 square feet; pressure allowed, 267 pounds per square inch; total weight of boilers with water, 400 tons; floor space occupied by one boiler, 7 feet 9 inches by 6 feet 6 inches; height from fire-room floor, 11 feet 4 inches. It is said that these boilers work very satisfactory. The steamer was built for the Northern Steamship Company by the Globe Iron Works Company, Cleveland, O.

Mr. Shipley, of the Lodge & Shipley Machine Tool Co., Cincinnati, recently visited New York in the interest of his firm. He reports an encouraging state of affairs, and says that for several months their trade has shown a gratifying increase, particularly in the special tools which they build.

More Powerful Than Steam.

I, for one, believe that we are on the eve of a great era of applicable force, and that the wasteful methods of steam and electricity will be relegated to a desuetude such as has overtaken the stage coach.

The grounds of my belief are based not wholly on hearsay, but chiefly on a curious experience. A few days ago a young man living in the vicinity of Boston took me to his room and showed me an apparatus which he had himself constructed with amazing ingenuity and skill. The fundamental primum mobile of this simple machine was musical vibration. I have no right to describe the apparatus, but the force produced in an incredibly brief interval of time by means of a fiddle bow, was so enormous that there seemed to be no way of measuring it, and the chief difficulty in the way of practical application lay in the regulation of this force, which, if directed, full upon a human being, the inventor believed, would instantly vaporize his body. A single drop of water confined in a hollow stoll tube was resolved by a small fraction of this possible energy into a motor capable of running an engine, if properly applied.

It is well known to all scientific men that a cubic foot of atmospheric air contains latent (if one might use the term), or in suspension, force enough to kill a regiment. Musical vibration seems to set free a portion of this energy, and its resources are infinite. If once they can be regulated it will be the simplest and most inexpensive way of doing all manual work, for it will require no heat.

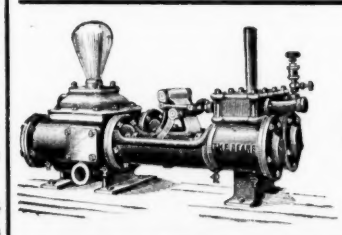
The young man who thought out this wonderful series of apparatus is self made, not having had great advantages of education; but for pure genius, I think, whether as a practical inventor or as a theoretical experimenter, he will take high rank among the great of the world.

The above, which was first printed in the *Transcript*, of Boston, and afterwards repeated in the Chicago *Inter-Ocean*, was sent to us by Elmer H. Neff, instructor at Purdue University, he remarking that, "No doubt mechanics and engineers will be gratified to learn something about the *marvelous* invention."

We readily recognize the symptoms in this case. It is the Keely motor over again, and it is easily conceivable that Keely has been able to collect another assessment on stock, based on the alleged competition of this Boston genius, who has, at a stroke, so to speak, accomplished all that Keely has accomplished in the way of showing the existence of this wonderful pent up power which can be "liberated by vibrations," but encounters the same obstacles to its practical use.

Large Electric Transmission in Norway.

A syndicate has lately applied to the Norwegian Government for a concession for an electric power transmission of some 20,000 horse-power from the Raanaas waterfall at Sörum and the Fossum waterfall at Askim, to the town of Christiania. It is understood that the plan of the installation is made by an English electrical engineer, and approved of by Lord Kelvin. It comprises the transmission of 20,000 horse-power to Christiania from the above two falls, but it is proposed to commence with a transmission of 10,000 horse-power. The tension is not to exceed 10,000 volts. The length of the line from the Fossum fall is close upon 25 miles; it passes through Spydelizerg, Tomter, Ski, and East Aker. The other, the Raanaas line, is about a couple of miles shorter, and passes through Sorum, Skedsmo, and East Aker. At the borders of the borough of Christiania, it is intended to build a distribution station, where the high tension current will be transformed and distributed to the various parts of the town by means of underground cables, the proposed tension varying from 100 to 400 volts. The installation cannot only supply convenient and cheap power for the larger and smaller industries of the town, but it is also under contemplation to supply the whole town of Christiania—or at least the part of the same which is not lighted from the central electric station—with electric light at a cheap price. The lighting of the public thoroughfares will, according to the plan, be effected by arc lamps of 2,000 and 1,000 candle power, according to the importance of the street, and the price will be much cheaper than that charged by the present central station. There will be several large turbines at each waterfall, which are some of the most important in Norway, and the high tension will be generated either direct or by transformers. It is proposed to use naked wires. The installation can, it is calculated, be completed in the year 1895, although much will depend upon the water level of the waterfalls, as the works in connection with leveling, damming, etc., require low water. The cost is calculated as 6,000,000 kr., or about 350 000*l*.—*Engineering*.



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MANUFACTURES.

An electric lighting system will probably be established at Ludlow, Ky.

The Nazareth (Pa.) Manufacturing Company will enlarge its mill this season.

The Garland Chain Company has completed its plant at Rankin Station, Pa.

D. S. Cook's Princess Furnace at Glen Wilton, Va. is going into blast again.

The Penn Rolling mill, at Lancaster, Pa., has started, after a long idleness.

A hundred more workmen have been added by the Birmingham (Ala.) Rolling Mill.

S. F. Dunn and G. W. Coughenour will locate an electric-light system at Scotland Neck, N. C.

Crane & Ford will enlarge their mill at South Hadley, Mass., and add an engine and boiler.

The Cumberland E ectric Light and Power Company will enlarge its plant at Nashville, Tenn.

The Citizens' Electric Light and Power Company is a newly organized concern at Pensacolo, Fla.

Manufacturing operations have begun at the McDonald Brass and Iron Foundry at Jefferson, Texas.

The wire-mill at Palmer, Mass., has been sold to New York parties, who will open a sash and blind factory.

The Hillsboro (Tex.) Power and Electric Company has purchased a site, and will erect an electric plant.

The manufacture of oil paper and oil linen for electrical purposes will be established at Schenectady, N. Y.

The Hess Storage Battery Company will establish at Springfield, O., a plant to construct the Hess battery.

The new electric railway system between Cleveland and Akron, O., will soon be in the course of construction.

The Union Metallic Cartridge Company will put in a 40x96 feet factory at Bridgeport, Conn., at a cost of $7,200.

The Manchester (N. H.) Locomotive Works have received an order for four locomotives, and started on full time.

Everything is in shape to begin operations at the new foundry plant of the Norwald (O.) Foundry and Machine Co.

The Wheeler Marine Shafting and Forging Co., of Jersey City, has been incorporated by Eldridge Wheeler, of New York.

All departments of the Cleveland (O.) Rolling Mill Company's plant resumed on July 1st, giving steady work to 4,000 men.

The Allentown (Pa.) Shoe Manufacturing Co. will erect two two-story brick additions to their plant. One will be 24 by 100 feet.

John Marquand and others of Cambridge, O., will build a rolling-mill for the manufacture of black plates for tinning purposes.

The Hess Warming and Ventilating Co. has been formed in Chicago, with capital of $10,000, to make heating apparatus. G. H. Hess is at the head.

No. 1 tin mill of the Briton Rolling Mill Company, of Cleveland, O., has gone into operation and two more mills will be put on by August 1st.

E. T. Hartwell, Oldtown, Me., has commenced extensive improvements in his planing-mill, which have been rendered necessary by increasing business.

The Doig Novelty Mfg. Co. has been incorporated in Baltimore, Md., and will build works in which to manufacture machine specialties. Capital, $20,000.

The plans for the new machine shop for the B. & A. R. R. Co., at Springfield, Mass., are completed and ground will be broken before the 1st of August.

The Peoria (Ill.) Automatic Filter Co. is announced as having been formed during the past few days by D. S. Brown and others with a capital of $50,000.

As soon as repairs can be m de the Douglas furnace at Sharpsville, Pa., will be put in operation by the lessees, Corrigan & McKinney, of Cleveland.

The Lukens Iron and Steel Co., of Coatesville, Pa., is erecting a brick machine shop, 60x50 feet, and intends to enlarge the shearing house in the near future.

Twenty nine furnaces are now working at the Wayne Iron and Steel plant at Pittsburgh. The bar-mill is the only department not working double turn full time.

The North Bros. Mfg. Co., of Philadelphia, manufacturers of hardware specialties, have completed a new foundry building 122x100 feet. It has capacity for 85 molders.

The Williams Palace Car Co., capitalized at $3,000,000, will immediately begin constructing cars in St. Joseph, Mo., to compete with the Pullman and Wagner Companies.

At the Anthony & Cushman tack shop, Taunton, Mass., which was recently started up, after a shutdown for several years, workmen are running until 9 o'clock nights on orders.

The capacity of the Radford (Va.) Pipe and Foundry Co. will be enlarged by an additional pit, a 96-inch shell cupola, new boilers, traveling crane and other machinery.

The Indiana Steel Casting Company is building a ten-gross ton open hearth steel furnace at Frankton, Indiana. It is expected to be ready for operations by August 1st.

Seven furnaces of the Illinois Steel Company are in blast at Bay View, Wis., one at Joliet and five at South Chicago. One of the North Chicago furnaces will go in blast soon.

The Beaver Falls (Pa.) Heating and Ventilating Co., just organized, will manufacture furnaces, heating and ventilating supplies. The capital stock of the company is $100,000.

The Bethlehem, Pa., Iron Co. has shipped two armor tubes and one thrust shaft for engine 147 to Cramps' ship yards, Philadelphia. The tubes weigh 14 tons and the shaft nine tons.

According to the *American Wool and Cotton Reporter*, 116 textile mills were constructed or undertaken in the six months ending with June, against 127 during the same period last year.

The property of Warren Zinc Company, at Warren, N. H., has been leased by the Electrical Zinc Company, of Portland, Me., and business will soon be resumed under that name.

The large nail and nail plate mills of the Ellis & Lessig Steel and Iron Co. (Limited), of Pottstown, Pa., were totally destroyed by fire recently. The plant had a daily capacity of over 1,200 kegs.

The Edgar Thomson steel works of the Carnegie Co., Braddock, Pa., has resumed in full, giving employment to 1,500 men. The plant has been closed several weeks on account of the fuel famine.

All departments of the Solar Iron Works at Pittsburgh are now on. The entire mill, with the exception of the open-hearth, went on when the coal strike was settled, and that department was put on since.

Julian Kennedy, Pittsburgh, Pa., has received the contract to erect a blast furnace for the Salem (O.) Iron Company, which will be 17x74 feet. The contract calls for the completion of the work in four months.

Work on the brick building erecting on Front St., for the New Bedford (Mass.) Boiler and Machine Company, which has been suspended for the past three weeks, waiting for lumber for the roof, will now be resumed.

The Sharon (Pa.) Furnace has been leased by W. C. Runyon, of Cleveland, and will be started on Bessemer pig-iron as soon as coke is available. The furnace was blown out in April. S. Allen Richards will be in charge.

The McMyler Car-dumping Machine Company, of Cleveland, O., was incorporated yesterday with a capital stock of $100,000. The incorporators are James Pickands, John McMyler, C. A. Judson, W. P. Murray, and A. C. Dustin.

The J. H. McLain Co., Canton, O., has issued a catalogue illustrating and describing their hot-water and steam heaters, of which they build a large variety. The illustrations are very complete, and the catalogue is a fine one.

An electric light company has been organized at Harrisburg, Pa., to establish at Lancaster, same State, an electric system. Among the Harrisburgers interested in the enterprise are J. W. Cattrell, A. S. Dellone and E. S. Herman.

A Pittsburgh dispatch of July 5th, says: All of the Labelle iron-mills at Wheeling, W. Va., resumed in all departments this morning, after a shutdown of nearly a year. Six hundred men are employed. The Riverside iron plant at Wheeling, employing 500 men, also resumed.

The Terre Haute Carriage and Buggy Company, at Terre Haute, Ind., are commencing to build a new four-story brick factory, which will be 100x60 feet. It is hoped to have it ready by September. Between one hundred and two hundred hands will probably be employed.

The Totten & Hogg Company, Pittsburgh, is erecting a lot of rolling-mill machinery for the

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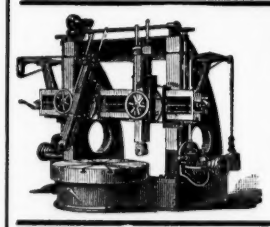

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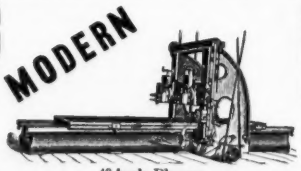
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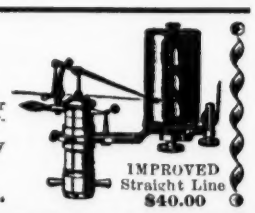

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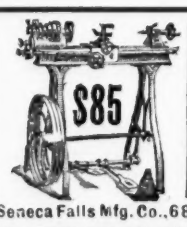

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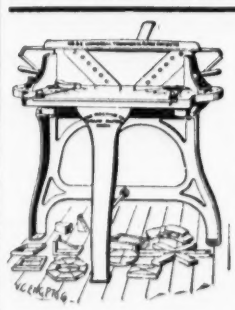

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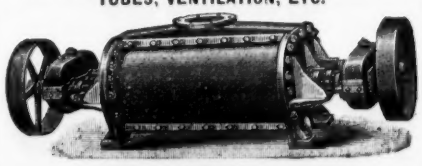

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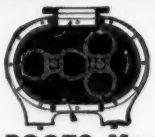

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276,320
HORSE POWER
ARE NOW IN USE.
SEND FOR SPECIAL PAMPHLET.
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ST. LOUIS, Eighth and St. Charles Sts.

Cumberland (Md.) Steel and Tin Plate Company, and the Irondale Steel and Iron Company, of Middleton, Ind. The company is now making a large double muck and bar shear for the Whitaker Iron Company, of Wheeling, W. Va.

Hine & Robertson Co., 61 Cortlandt street, New York, have furnished a set of three indicators, three wheels and three planimeters to the Easton Traction Co., Easton, Pa., which the builders believe to be the finest set of instruments, including case and all belongings, ever put up. One elegant case contains all the instruments.

The Kansas City Steel and Iron Works will definitely locate at Argentine, Kan. They will occupy a building erected some years ago for the manufacture of radiators, but not used. The new company will put a force of 50 men at work as soon as the plant can be put in operation. Car couplings and other appliances will be manufactured.

The Reading (Pa.) Iron Co. is now finishing a shaft 19 inches in diameter by 36 feet long, with cranks, and has also under way another finished shaft 24 inches in diameter by 20 feet 6 inches. A new system of assorting scrap has been adopted lately which will minimize the danger of the mixing of foreign material, occasionally found in blooms and forgings.

The addition to the steel mill of the Scottdale (Pa) Iron and Steel Co., has been completed, and will be put in operation within a few days. Over 300 men are now given employment. The addition to the machinery of the plant consists of two new finishing rolls, a train of cold rolls, with the required annealing, and heating furnaces, etc., and a battery of three boilers.

In connection with the announcement that the Schenectady (N. Y.) locomotive works will start Monday on a new order, comes the information that the Edison General Electric Company has received a large contract for more than 100 electric motors for the Metropolitan Electric Railway Company, of Chicago. This is grateful news for the unemployed mechanics of Schenectady.—*Troy Times*, June 29th.

The Johnston Harvester Co., Batavia, N. Y., write us: We have been interested in an article contained in your excellent paper under date June 28th, by Frank Richards. We are desirous of securing an air compressor that may be used for air lifts throughout our foundry, and in a few other places. We are also desirous of using the same compressor for vaporizing crude oil in our blacksmith shop. Have you or Mr. Frank Richards any information at hand that would be of use to us in securing the best and most reasonable compressor, and probably a reducer, for this purpose?

Machinists' Supplies and Iron.

NEW YORK, July 7, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.50 to $13.00; No. 2, $11.25 to $12.00; Gray Forge, $10.25 to $10.50. Southern brands are quoted at $11 50 to $12.25 for No. 1 Foundry; $10.50 to $11.00 for No. 2, and $10.00 to $10.25 for No. 3.

Antimony The market is dull and weak. We quote L. X.. 8¾c. to 9c.; Cookson's 10c. to 10¼c.; Hallett's, 8.50c. to 8 60c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 55c. to 57c.

Copper—The market is steady, but without business of any importance. Lake Copper is quoted at 9½ cents for spot. Casting Copper per car load is quoted at 8.70c. to 9 00c.

Lead—The market remains firm Supplies are scarce for prompt delivery, and prices are steady at 3 40c. to 3.42½c.

Spelter—The market is steady, at 3.45c. asked, and 3.35c bid for spot.

Tin The market is quiet. For spot 19.30c. is asked, and 19.25c. bid.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Sit. by young German draftsman; tech. education; 3 years' experience. S., AM. MACHINIST.

An exp'd designer and draftsman on fine mach'y, wants a position. BOX 113, AM. MACHINIST.

Practical mech. draftsman wants pos., machine tools and general mach'y. Box 116 AM. MACH.

Wanted—An exp'd designer and draftsman on electric traveling cranes. BOX 118, AM. MACH.

Draftsman—Mech. grad. from tech. school and 5 yrs. exp. want pos. Wm. Dieter, 657 Kosciusko St., Brooklyn, N. Y.

Wanted—A master mechanic to take entire charge of shops employing 250 men; must have wide experience. Box 109, AMERICAN MACHINIST.

A mechanical engineer with experience in designing machinery and in handling men, desires a position. Address O. Hi. O., AMERICAN MACHINIST.

Expert machinist and toolmaker had to give up his own business; open for engagement as foreman; good refs. A. B., AMERICAN MACHINIST.

Experienced machinist desires pos. as assistant supt. or foreman, well up in piecework methods, can handle men to advantage, and can duplicate work; best refs. Energy, AMERICAN MACHINIST.

[The above advertiser, "Energy" is requested to send his name and address to the AMERICAN MACHINIST.]

Wanted—Machinist to take charge of the erecting department. Must be competent and energetic; exp. with presses and shears desirable. Give references and state wages wanted. Niagara Stamping and Tool Co., Buffalo, N. Y.

A chief draftsman and designing eng'r has extended exp. on multi-cylinder Corliss & high-speed engines, gas engines, air compressors, hoisting, mining and transmission mach'y, desires pos. in N. Y. City or vicinity. H. L., AM. MACHINIST.

General and business manager wanted for large steel casting concern, with large important specialties Only those familiar with the manufacture of steel and of proved high executive and business ability need apply. Wilson, 51 Tribune Building, N.Y.

Wanted position as foreman or superintendent of foundry; capable and of large experience in all classes of foundry work; well up in modern methods and appliances and can handle men to advantage; A1 references. Box 115, AMERICAN MACHINIST.

Young designing eng'r has several valuable patents pertaining to steam eng'ring & a varied experience through the first shops of the country is thoroughly posted on land eng'ring home & abroad seeks engagement with a consult'g and constructing eng'r in N. Y. C., Boston or Phila., S. P., AM. MACH.

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Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Wanted—To buy good second-hand tools. Box 83, AMERICAN MACHINIST.

For Sale—"Zerah Colburn's Locomotive Engineering," 2 vols., strongly bound, unsoiled, $7. Box 117, AMERICAN MACHINIST.

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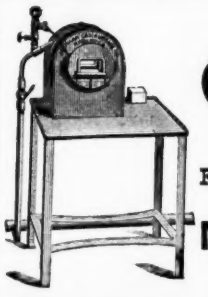

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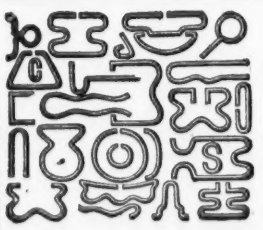

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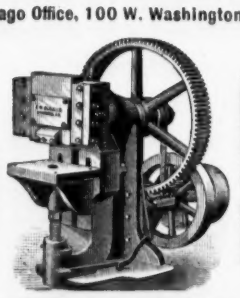

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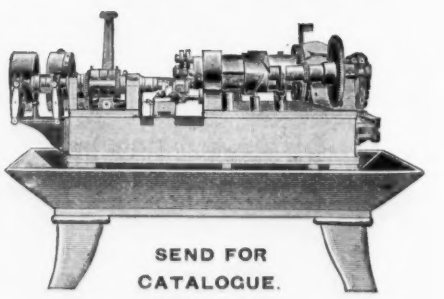

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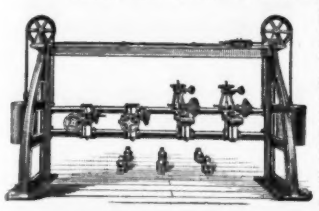

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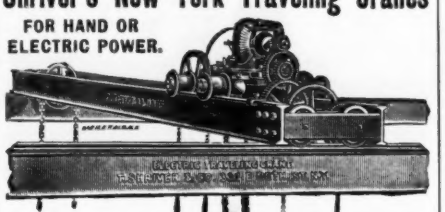

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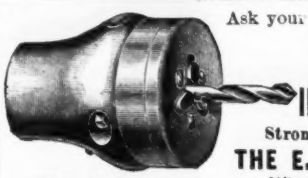

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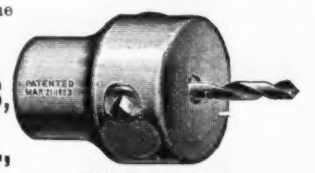

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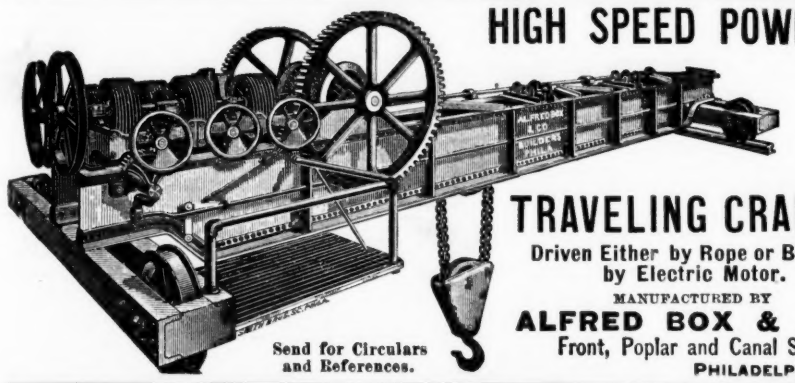

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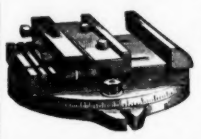

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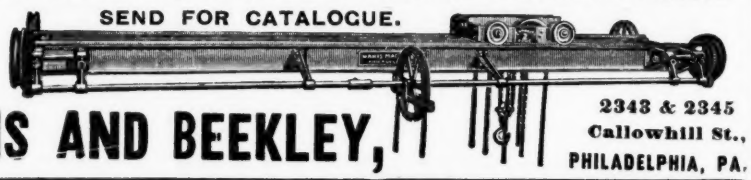

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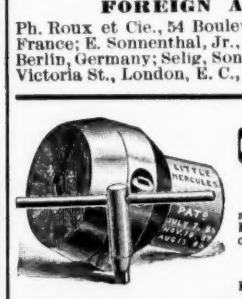

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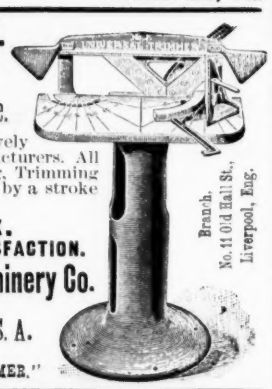

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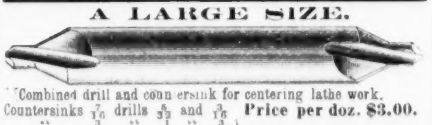

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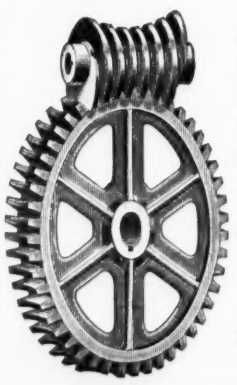

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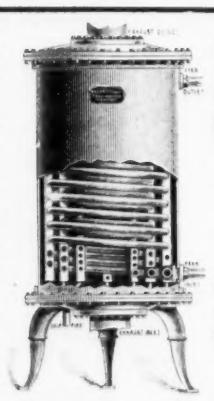

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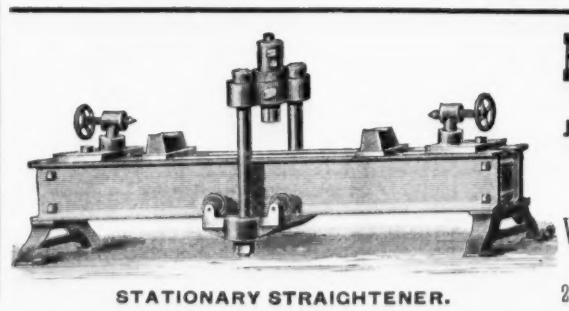

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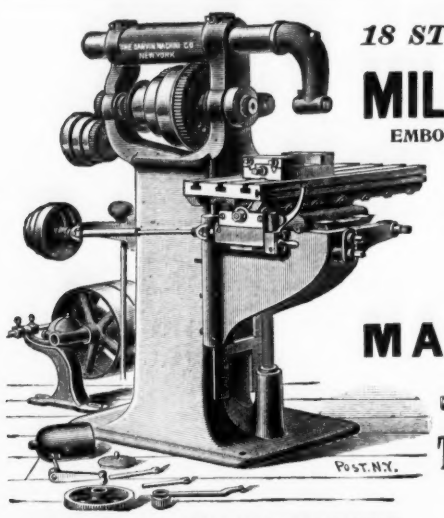

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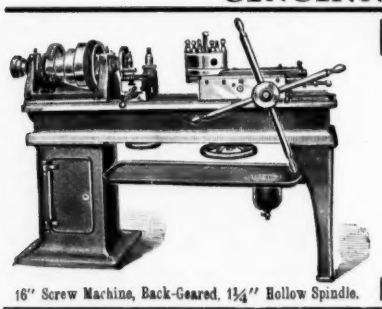

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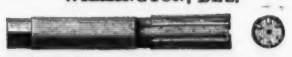

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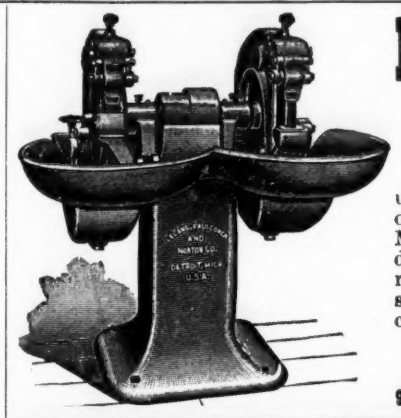

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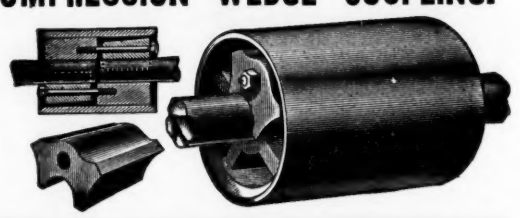

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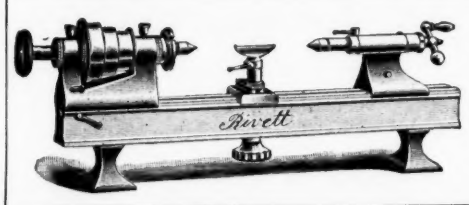

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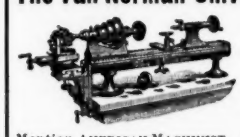

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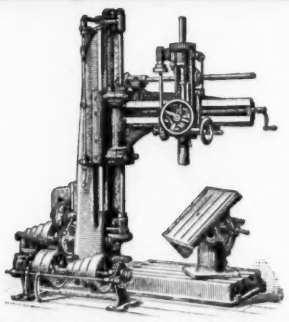

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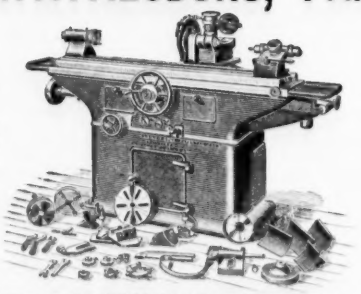

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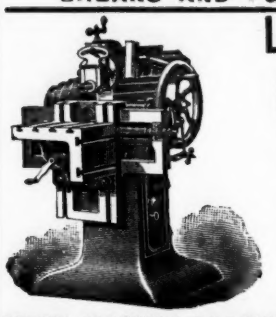

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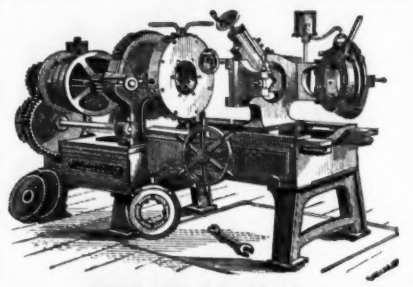

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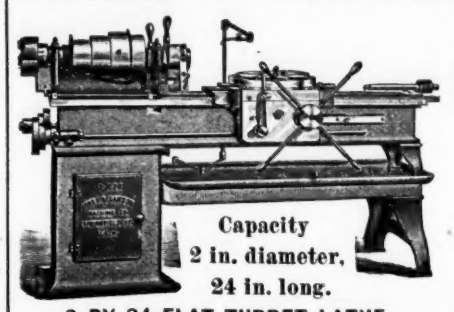

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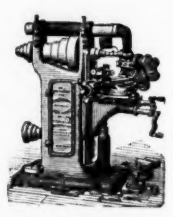

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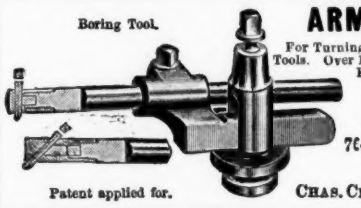

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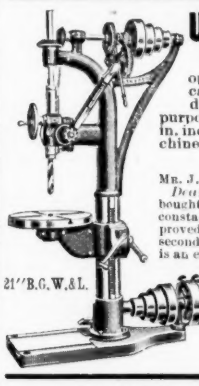

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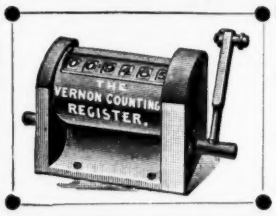

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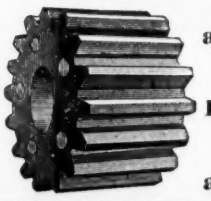

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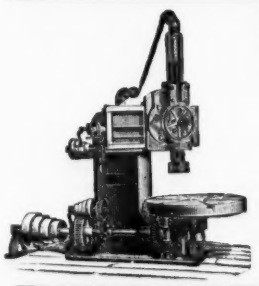

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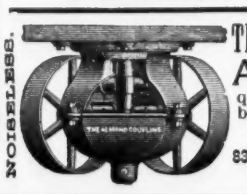

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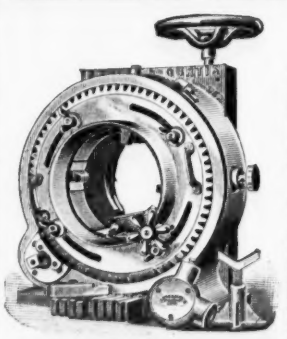

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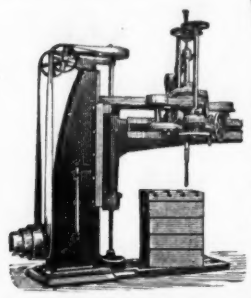

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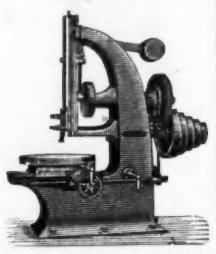

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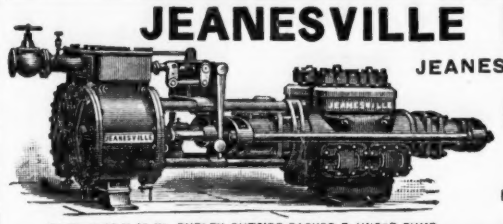

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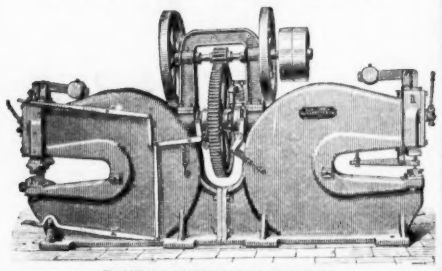

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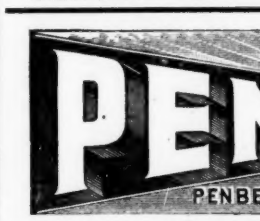

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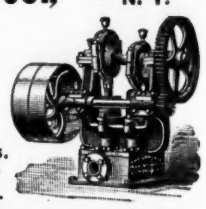

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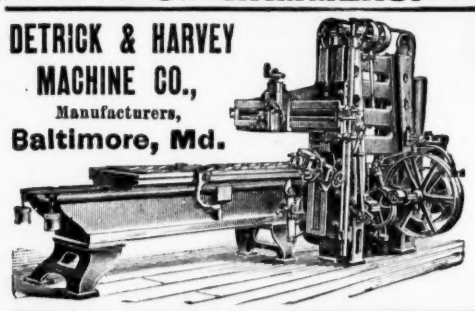

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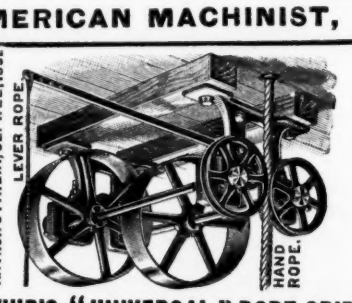

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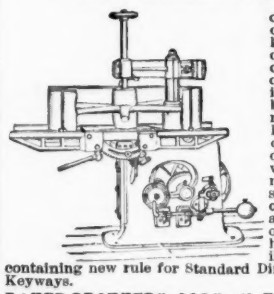

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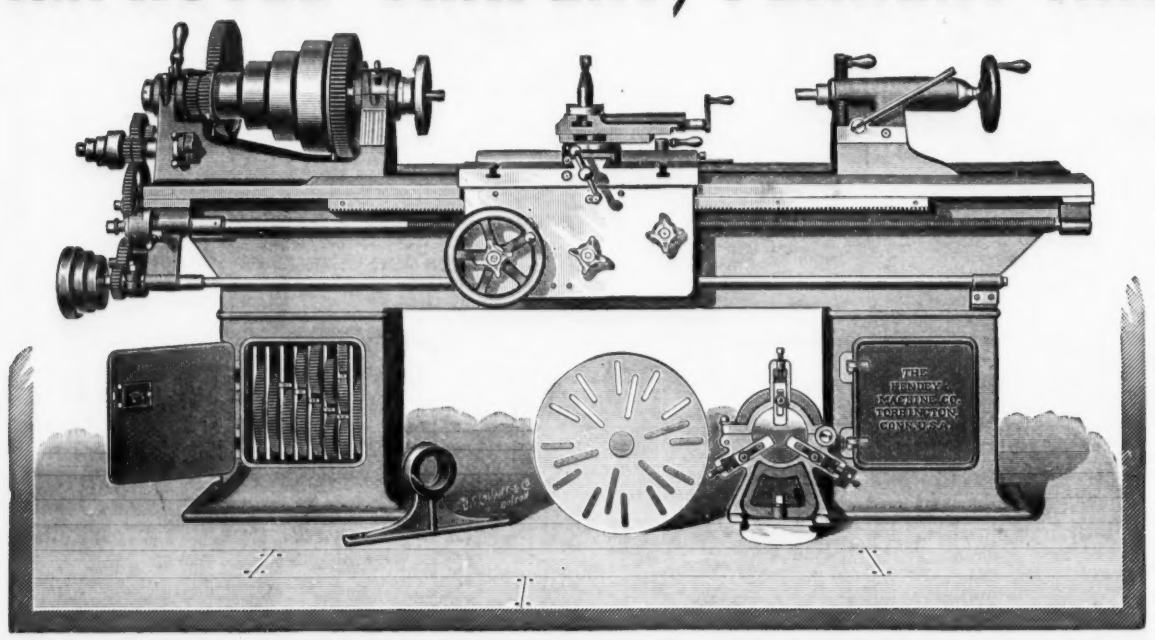

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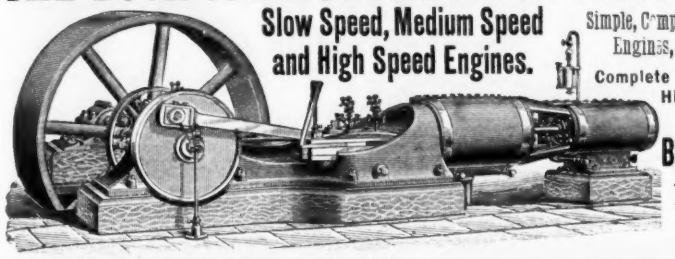

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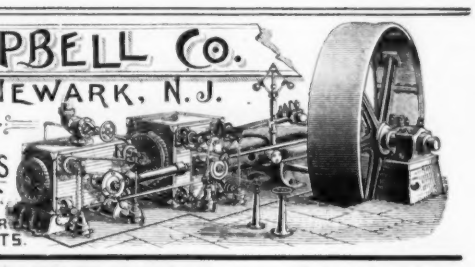

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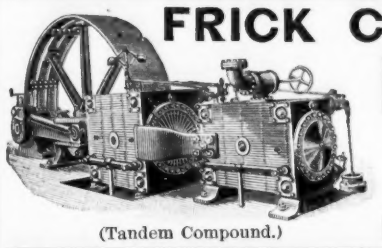

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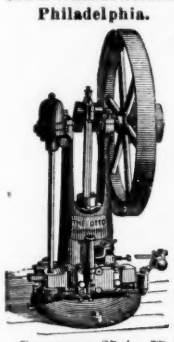

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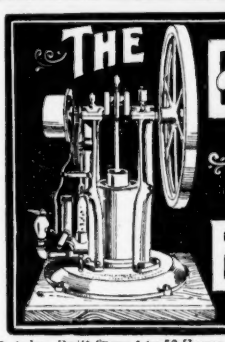

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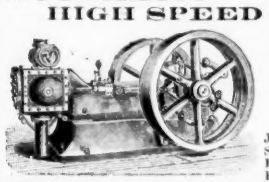

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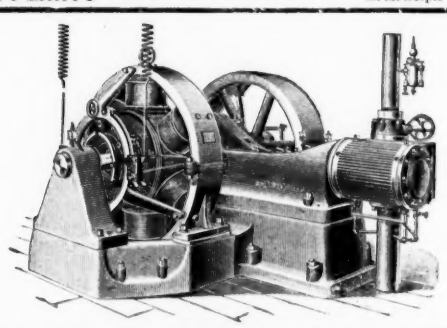

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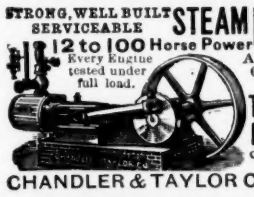

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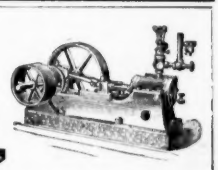

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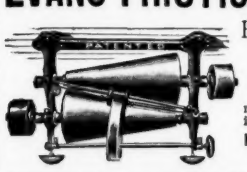

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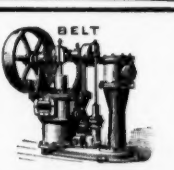

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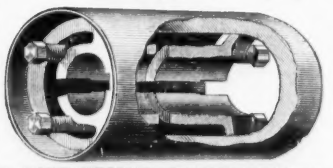

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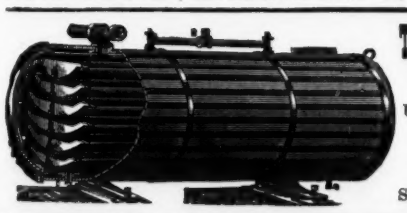

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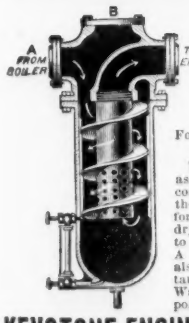

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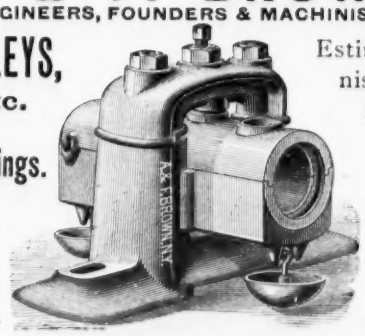

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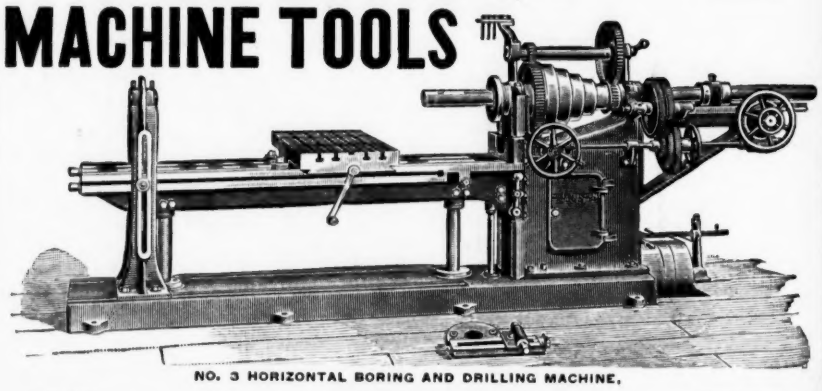

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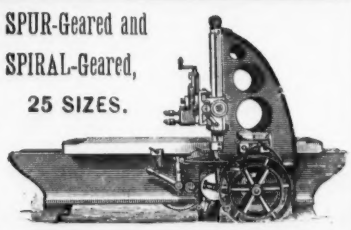

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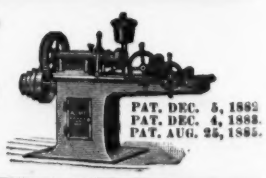

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